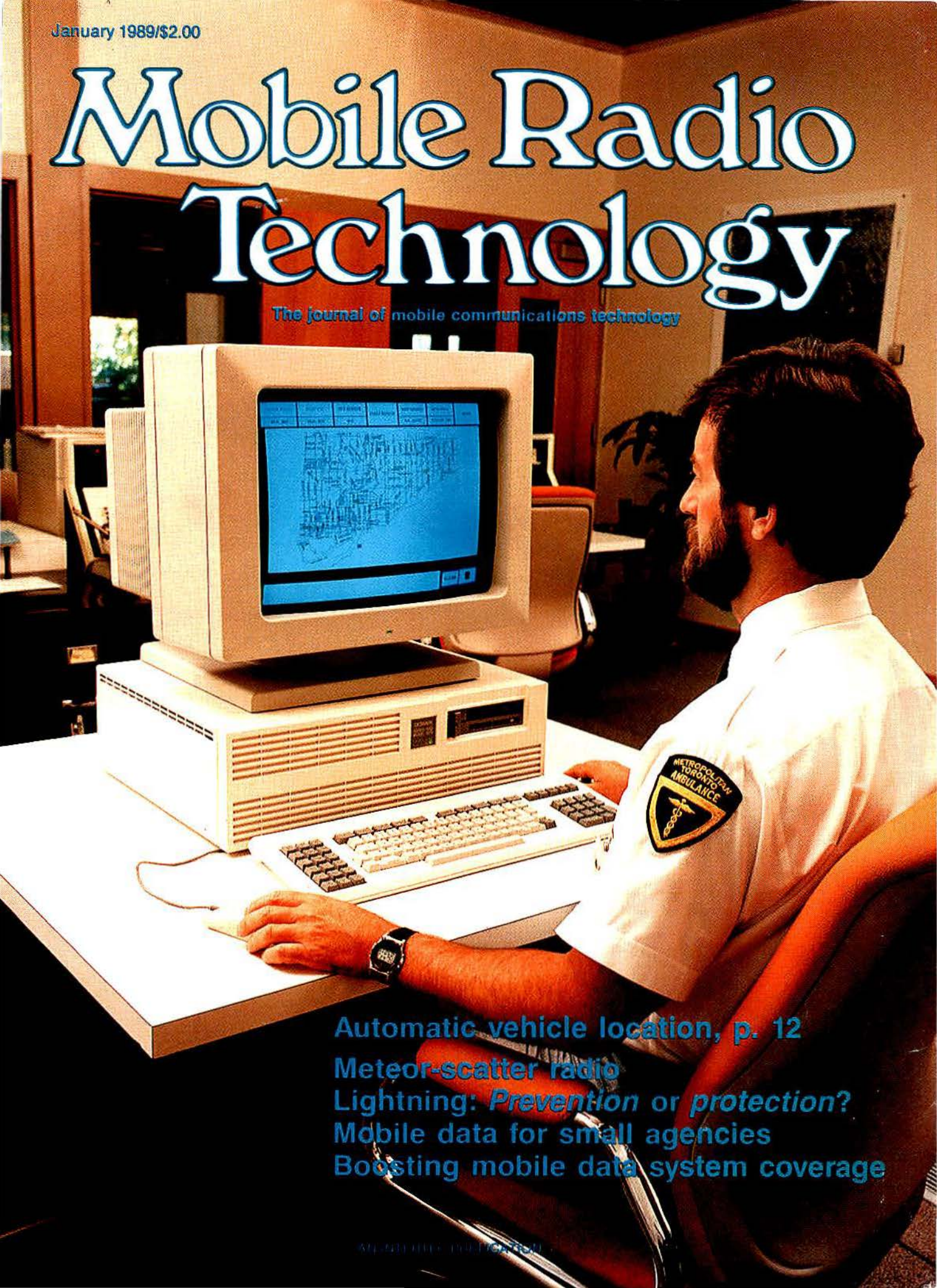
January 1989/$2.00

Mobile Radio Technology

The journal of mobile communications technology



Fifteen years ago we ran the first vehicular patterns for an experimental communications idea dubbed "cellular." Since then, we've led cellular antenna technology every step of the way — from the first design concepts to our world famous "ON-GLASS"® antennas. In fact, we developed the specifications and configurations with Bell Laboratories for all three basic cellular antenna designs that exist today.

We've known from the start that to build antennas that perform best and last longest, we've got to keep pushing technology forward a little bit more each day. You see the results of our work in our constant performance innovations — new parts designs resistant to corrosion and noise-generating vibrations, refined contacts and mountings, even our special cable and crimp connections.

That's why cellular professionals choose A/S again and again. We've already delivered over a million cellular antennas — more than all other manufacturers combined — almost as many antennas as there are subscribers.

Now we're looking to the future. It's the only place to find antennas that perform better than ours.

Send for your free copy of "THE BOOK" on cellular antennas. Helps you choose from over 40 A/S models — the most extensive, profitable line in the industry.

With a million cellular antennas behind us, our only real competition is the future.

35th ANNIVERSARY

the antenna specialists co.

a member of The Allen Group Inc.

®"Stripes of Quality"

30500 Bruce Industrial Parkway
Cleveland, OH 44139-3996
TEL: 216/349-8400
FAX: 216/349-8683 TLX: 4332133

MADE IN U.S.A.

Circle (1) on Fast Fact Card

For every remote possibility!

Tone-remote and DC-remote desk-top consoles

Cetec Vega offers tone-remote and DC-remote consoles for virtually all applications. Some of the popular console types shown above include:

- Two-frequency EIA sequential tone
- Four- and eight-frequency EIA
- Dial-up (plugs into ordinary telephone line)
- PTT/monitor DC
- Full-function DC
- Vega "SPEECH-PLUS" and other continuous-tone formats
- Multiple-line
- OEM and custom (special features and extended functionality)

Most Cetec Vega consoles offer a wide array of deluxe features at no extra cost, such as:

- Multifrequency (2, 4, or 8) operation
- Selectable 2-W simplex or 4-W full-duplex operation
- Intercom function
- High-performance audio with 2-way compression
- Reliable push-button switches

Also standard is the reliability, quality, and support you expect from Cetec Vega.

For applications assistance, custom designs, and special requirements, call **1-800-877-1771** (and remember to ask for your *Signaling Products Catalog*).

Cetec Vega

Division of Cetec Corporation
9900 Baldwin Place
El Monte, California 91731
Telephone: 800-877-1771;
(818) 442-0782
Telex II: 910-587-3539
FAX: (818) 444-1342

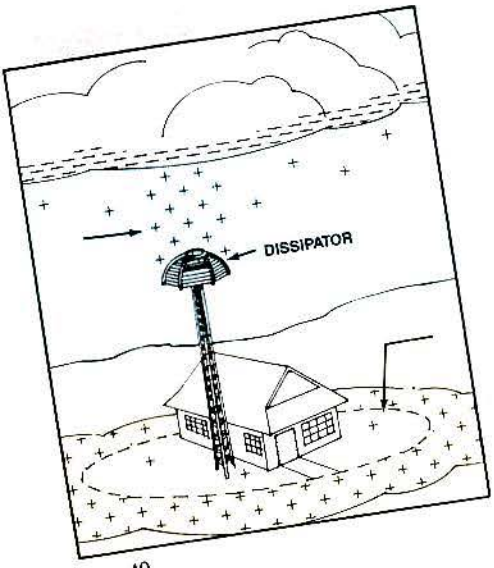
Circle (4) on Fast Fact Card

Contents

Mobile Radio Technology

Volume 7, Issue 1

The journal of mobile communications technology



page 40

page 54

features

On the cover: A Toronto ambulance service dispatcher uses an automatic vehicle location system map to match the best available vehicle with a request for aid. See article on page 12.

departments

Higher profit margins, reliability you can count on, and fast delivery. That's SSC.

You win the bid. With a 50% markup.

To make it easier for you to maintain higher profit margins, we keep our prices extra competitive.

We can do it, because signalling is our specialty.

You'll like our reliability.

Profits disappear quickly if you have to make several service calls—at your expense!

You'll be pleased with the reliability SSC delivers. It's backed up with a five-year limited warranty.

You get your order when you want it. Fast.

A recent survey showed there's a 90+ percent chance your order will be shipped within five working days of SSC's receipt of your order.

In any case, we'll give you a firm shipping date and we'll make it happen.

Full-line of signalling products.

Take your pick. DC and tone remote control units, DC to tone converters, ANI encoders and displays, CTCSS, single-tone, two-tone sequential, and Touch-Tone® units.

The new desktop or wall-mount remote control console pictured above is available in DC or tone, with a full range of features. You can field program it during installation to ensure system compatibility.

Ask for information. It's free.

You'll receive a complete package of information on signalling products designed to raise your profit margins. Contact Solid-State Communications, 21060 Corsair Blvd., Hayward, CA 94545.

SSC *One source for all your signalling needs.*

Call now for full information package: Circle (5) on Fast Fact Card

800-227-1226 IN CA **800-227-0223**

Broadcasters win one for land mobile? How's that again?

Two groups, broadcasters and land mobile radio system operators, use the same natural resource: electromagnetic spectrum, the frequencies that carry radio communications and radio and TV broadcasts.

Competition for access to that resource has pitted the two groups against one another. Land mobile interests have won their share of tussles:

- UHF-TV channels 70 to 83 were wrested from broadcasters. Portions of that spectrum, when reassigned to land mobile, made possible cellular mobile telephone service, specialized mobile radio service, expanded private and public safety two-way radio services and expanded paging services.
- Broadcasters have been required to share UHF-TV channels 14 to 20 with land mobile system operators in certain urban areas, an action especially helpful to public safety agencies with vital communications requirements.

Nevertheless, broadcasters remain skillful lobbyists. Possible land mobile/UHF-TV sharing of channels above channel 20 has been postponed indefinitely because of last year's successful lobbying effort based on the potential use of UHF-TV spectrum for advanced TV broadcasting techniques.

Forest Service fees

That brings us to the point where broadcasters have won one for land mobile.

Mountain peaks or ridges with commanding views of populated areas offer advantages for antenna placement. Suitable peaks and ridges made available for antenna placement on land administered by the U.S. Department of Agriculture's National Forest Service are designated as "electronic sites."

The Forest Service proposed a new fee schedule for electronic site users. It boosts fees as much as 10 times or more for some users—broadcasters and land mobile system operators among them.

Land mobile operators' efforts to pursuade the Forest Service to moderate the schedule were largely unsuccessful.

Then the National Association of Broadcasters (NAB) weighed in. Where it made a difference. Congress.

The NAB mustered support in both Houses.

Sen. Pete Domenici (R.-NM) wrote to Forest Service chief F. Dale Robertson, asking him to delay implementation of the new fees so Congress can conduct hearings about them. Rep. Bill Richardson (D.-NM) drafted a resolution to block the rate hikes.

Robertson postponed the new fees at least until March 31. Fees previously have been billed the following November, to be paid by Jan. 1, so the postponement is, in effect, for a year.

Although land mobile thus benefits from the broadcasters' efforts, land mobile representatives must carry their own case forward from this point.

Land mobile has to show that Forest Service appraisals are too high, that they do not reflect fair market value.

Broadcasters may not have to. They may find protection in the Federal Land Policy and Management Act of 1976. An NAB press release reads that the act "provides specifically for waivers to users of federal land who provide benefits without, or at reduced, charge." Broadcasters "provide valuable public benefits absolutely free of charge to local citizens," according to the release.

Broadcasters won a reprieve for land mobile. Now it is up to land mobile representatives to make their case for a more reasonable fee schedule.

—Don Bishop

PRIVACY NEWS from transcrypt

Volume 1, No. 4

NEW TECHNOLOGY FOR TODAY'S RADIOS

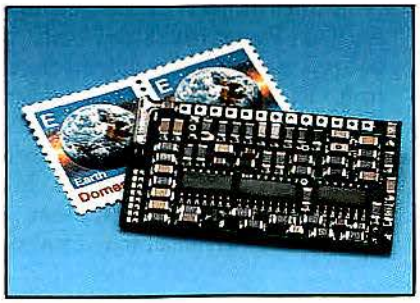
Nobody does it better

VOICE PRIVACY

Whether you need four codes or four billion, Transcrypt has the reliable system for your radios.

Now with advanced features like ANI, Status reporting and Selective Calling, Transcrypt's CVP™ is unmatched by any other system.

Specified and depended on by major users and governments world wide.

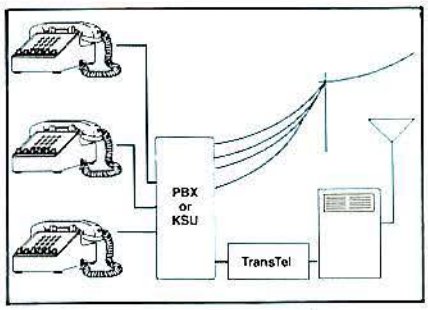


Transcrypt's voice privacy modules go to work every day in over 400 different makes and models of radio.

Unique Remote

NEW

Control a base station using your existing telephone system. A single TransTel™ replaces costly remotes and permits control of the base from any telephone extension. (DTMF required)



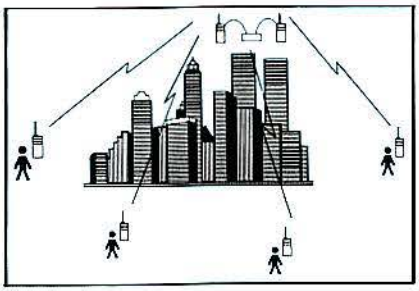
Transcrypt's TransTel™ replaces remotes

Instant Repeater

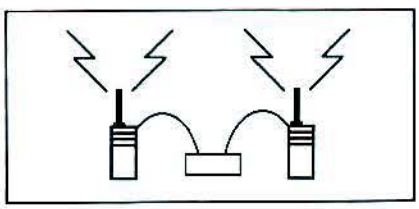
NEW

Whether fighting forest fires in the Northwest or providing emergency communications after a hurricane, Transcrypt's remarkable TransPeater™ goes to work faster than any other system.

Using programmable radios, simply connect the TransPeater™ between any two units (portable, base or mobile) using existing micro-phone/speaker connections.



Transcrypt's TransPeater™ provides instant repeater service



Transcrypt's TransPeater™ easily connects two radios as a repeater

Bendix/King Users

NEW

Special upgrades for KING portables in VHF & UHF. Plug in options for unit to unit selective calling, voice privacy and more. Also a new low cost 28 channel conversion for the VHF LPH series.

ti

transcrypt international INC.

Toll-Free (800) 228-0226 Telex 466146

1620 North 20th Street, Lincoln, NE 68503

Letters to the editor

The policy of "open architecture" and the suggested implementation process found in the August 1988 issue's editorial elicits the following response:

A report entitled, "900MHz Trunked Communication System Functional Requirements Development" was the result of APCO Project 16 and was released in March 1979. As described in the executive summary, this document's purpose "is to define those specific characteristics and functional capabilities that such a system should have."

Further, "It also lists desirable features that may be selected, should they be required by individual procuring agencies." Donal D. Kavanagh was the director of projects and is identified on page 52 of the August issue as one of the founding directors of Open Architecture Radio for Public Safety (OARPS).

In Mr. Kavanagh's "Acknowledgements," which are a part of the report, he praises the contributors for their "professional skills, initiative and dedication" and recognizes not only their "in-depth knowledge of their field, but [that] they must also possess the imagination and foresight needed to perceive how new and heretofore unknown concepts can be applied to the solution of present and future problems."

The body of contributors consisted of representatives of the Law Enforcement Assistance Administration (LEAA), Associated Public-Safety Communications Officers (APCO) and public safety professionals from Kentucky, Arizona, Pennsylvania and Utah. Vendor representatives included personnel from RCA Mobile Communications Systems, General Electric, E. F. Johnson, Repco, U.S. Communications, Kokusai Electric and Motorola. In all, more than 50 communications and public safety personnel were involved in contributing to the development of public safety trunking guidelines.

The report included system development, system description, system elements and system-related considerations including Sections 4.5 and 4.6 dealing with intersystem and conventional system interfaces.

The point is this: Open architecture was not listed as a requirement of public safety trunking or even as a "desired feature." Cellular telephone service required commonality of protocol in the development process, but trunking is a different type of service.

One can assume that, with this published report, each vendor had equal knowledge of the requirements and as free to pursue research and development of its technology, protocols and equipment to satisfy those requirements of APCO. Or they could have made a management decision not to participate in this new marketplace and technology.

Mobile Radio Technology

The journal of mobile communications technology

EDITORIAL
Don Bishop, *Editorial Director*
Jane Bryant, *Staff Editor*
Tom Cook, *Senior Managing Editor*
Andrew Naugher, *Editorial Assistant*
Pamela S. Fleener, *Group Editorial Assistant*

ART
Terri Blunt, *Graphic Designer*

INDUSTRY CONSULTANT
Fred M. Link

EDITORIAL ADVISORY BOARD
Gene A. Buzzi, *President, Omnicom Telecommunications Engineering, Tallahassee, FL*
R. James Evans, *Communications Consultant, East Lansing, MI*
Gary David Gray, P.E., *Chief Telecommunications Engineer, Orange County Communications, Orange, CA*
Frederick G. Griffin, P.E., President, *Frederick G. Griffin P.C., Lynchburg, VA.*
S.R. McConoughey, P.E., *Mobile Communications Consulting, Gaithersburg, MD.*
Art McDole, *Director of Communications, Monterey County, CA.*
F. Stuart Meyer, *Land Mobile Consultant, Vienna, VA*
Herb Sachs, *Herb Sachs Consulting, Bowie, MD*
Leon Spencer, *Radio Engineering Systems, Exxon Company USA, Houston, TX*
Dr. Gregory M. Stone, *Director of National Security and Public Safety, RJO Enterprises, Lanham, MD.*
Kenton Sturdevant, *Assistant Vice President, Forest Industries Telecommunications, Eugene, OR*
Raymond C. Trott, *President, Raymond C. Trott Consulting Engineers, Irving, TX*

BUSINESS
Cameron Bishop, *Group Vice President*
Eric Jacobson, *Publisher*
Mercy Contreras, *Associate Publisher/ National Sales Manager*
Stephanie Hanaway, *Promotions Manager*
Kelly Hawthorne, *Promotions Coordinator*
Dee Unger, *Advertising Business Manager*
Liz Turner, *Advertising Coordinator*
Kevin Callahan, *Creative Director*

ADMINISTRATION
R. J. Hancock, *President*
Charles Rash, *Corporate Circulation Director*
Jo Ann DeSmet, *Circulation Fulfillment Manager*
Sandra J. Stewart, *Circulation Director*
Dee Manies, *Circulation Coordinator*

ADVERTISING: Regional sales offices listed in classified section.

MOBILE RADIO TECHNOLOGY provides technical information to dealers, community repeater operators, specialized mobile radio operators, conventional RCC, WCC, cellular RCC, WCC, mobile radio equipment manufacturers, manufacturers' representatives, distributors, engineering, consulting firms, national government, military agencies, state/local government, public safety agencies, transportation companies, petroleum/energy products companies, public utilities and others allied to the field.

CORRESPONDENCE: Editorial, advertising and circulation correspondence should be addressed to P.O. Box 12901, Overland Park, KS 66212-0930, 913-888-4664, telex: 42-4156 INTERTEC OLPK, fax: 913-541-6697.

SUBSCRIPTIONS: MOBILE RADIO TECHNOLOGY is circulated without charge in the United States by name and title to personnel who are responsible for sales, operation or maintenance of mobile radio equipment. Non-qualified subscriptions in the United States are $30 per year; in Canada, $36 per year; and in other countries, $40 per year. Foreign airmail optional at an additional $65 per year. Single copies are $2 plus postage and handling; back issues, $3 plus postage and handling. Adjustment necessitated by subscription termination at single copy rate. Allow six to eight weeks for change of address or for new subscription.

$2.00 + 0.00

VBPA ABP

Audited circulation.

INTERTEC PUBLISHING

MODEL 710

NOW! THE MICROPHONE MOST IMITATED IS BETTER THAN EVER!

New Store and Send Feature Saves Valuable Airtime and Practically Sells Itself . . .

710/860 SERIES KEYPAD PROGRAMMABLE AUTO-DIAL, AUTO ANI, DTMF ENCODING MICROPHONES & HANDSETS


MODEL 860

NEW FEATURES:

- Store and Send format; Reduces Airtime and Eliminates Transmitting Wrong Numbers
- No Battery Required, Retains Programming Memory for 100 Years (Non Volatile)
- Fully Programmable; No Manual/Auto Switch to remember to change
- Board Mounted Cord Connector; Reduces internal wiring and improves long term reliability
- Proven coiled cord strain relief exceeds the requirements of FAA 20 kilogram pull test
- Coiled cord flex relief exceeds the requirements of Military Standard C-55668
- Improved PTT Microphone Switch; Exceeds 1 million closures without failure

OTHER FEATURES:

- Autodialing of up to Nine 21 Digit Numbers
- Backlighted Silicone Rubber Keypad
- Single Key Last Number Redial
- Level Matching for most transceivers
- Auto PTT with any Digit
- Audible DTMF Sidetone
- Automatic Microphone Muting
- Auto Encode of Two 21 Digit ANI's
- Auto Dial and Auto ANI Speed Changes
- Auto Dial Pauses with or without PTT
- Full Year Parts and Labor Warranty

ADDITIONAL 860 FEATURES:

- Transmit & Power LED's
- Off Hook Speaker Mute
- On Hook Dialing
- Supplied Complete with Cradle and Cable

Make The *RIGHT* Connection

CES Communications Electronics Specialties, Inc.

931 S. Semoran Blvd., Suite 218 Winter Park, Florida 32792
National: (800) 327-9956 Local: (407) 679-9440 FAX: (407) 679-8110

Circle (7) on Fast Fact Card

Letters to the editor

If Motorola does indeed have "an estimated 98% market share," then its action could be described best in the words of Nathan Bedford Forrest, who said (in describing his success as a general): "Get there fustest with the mostest."

There is no guarantee that Motorola's dominance will continue in this marketplace as other manufacturers finally gear up to compete for the business. This outcry for open architecture plainly smacks of jealousy of Motorola's early success. Your editorial gave percentages, but how many systems does this represent? What is the potential number of systems for this technology?

Consider what government intervention might do to future technological advancements should OARPS be successful. There would be a strong message sent out to the leaders of any industry that, if you are successful at what you do, you might be forced to share that success with others who have not spent the time and effort and money to develop their own product. That would be a disastrous disincentive that America does not need.

Such an action also would allow the off-shore, "me-too" products to have a competitive advantage over the manufacturers that have legitimately responded to APCO's request to develop a system that meets the guidelines found in APCO Project 16.

Finally, the process you outlined as "the way competitors can make use of government machinery to gain entry into the public safety trunked radio market" is an abhorrent idea for the American free enterprise system. This concept should be rejected.

Tim Curbow
General Manager
Central Communications & Electronics
Knoxville, TN

During a panel session at APCO's 54th Annual National Conference in August 1988 in Little Rock, AR, Motorola vice president David Wooldridge said trunked public safety radio systems supplied by his company number more than 100. General Electric product manager Pat Murphy said her company has supplied six such systems. Motorola's market share is estimated at 98% because many systems it has supplied are much larger than those supplied by GE.

The potential number of systems for the technology is at least in the thousands.—DB

July 1988's issue included the following letter:

Finding good, *rugged* portables is a problem.

H. Longino
Travenol Labs
Cleveland

A reply from Midland LMR:

When we introduced the Midland 70-043/143 portables, we said they were

FOR SPEED AND SIMPLICITY IN CELLULAR TELEPHONE TESTING...

Marconi's 2957 Cellular Radio Test Set drives you to the finish line while others are warming up their equipment.

Just press a single button and immediately know if the radio passes or fails. If in-depth tests are required, the powerful duplex display of the Model 2957 allows monitoring of key transmitter and receiver measurements simultaneously. Now you can perform fault analysis or adjust the radio to meet EIA or carrier specifications.

All this plus...

- Full cell-site simulation
- Parallel/serial/IEEE printer output ports
- Non-volatile storage of local operational parameters
- Full line of accessories available including: audio break-out box, disk drive for storing custom test routines and more.

Cross the winner's line to efficiency. Call or write for literature or a demo.

Marconi Instruments,
3 Pearl Court, Allendale, NJ 07401,
1-800-233-2955 • (201) 934-9050

Marconi
Instruments

Circle (9) on Fast Fact Card

extremely rugged little radios. Here is one that went way beyond the call of duty, only two days out of the box.

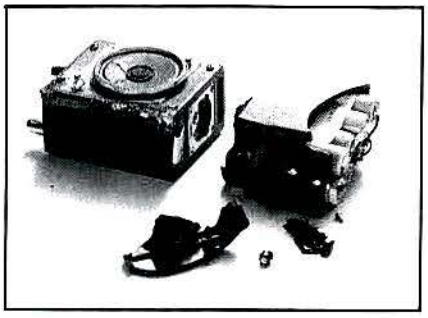
Climbing up into the cab, the driver of the huge scavenger truck shown here dropped the radio without realizing it. When he pulled out, all of the driver's side double wheels of the tractor and trailer ran over the radio, smashing the front cover and battery case.

But, to everyone's astonishment, when a new battery was twisted on, the radio worked fine...the die-cast chassis had protected all the radio compartment components, including the speaker. So the owner naturally brought the radio back to his dealer, RMA Telecommunications of Mt. Kisco, NY, for a new cover and battery.

Instead, RMA president Bob Manzella graciously gave the owner a new radio and sent the battered but still functioning one to us for a prominent place in the Midland LMR "Survivors Hall of Fame."

This truck . . .

ran over this radio . . .



driver shows off its replacement.

Ernie Krahenbuhl
Vice President of Marketing
Midland LMR
Kansas City, MO

The March 1988 issue had helpful information on batteries and battery applications. I especially liked the article, "Fast Charging Nicad Batteries," by N. Hershkowitz and C. Forest.

J.K. McNeal
J J Henry Company
Northfield, NJ

Sorry, but the era of the overpriced instrument has come and gone, and in its wake comes the CT Systems 3000S Service Monitor.

A full-featured Service Monitor with Spectrum Analyzer for only $6295.

We've combined the proven reliability of our 3000B with the added advantages of our full-featured spectrum analyzer. The result...a tough, reliable, full-featured Service Monitor that, at only $6295, delivers the best price to feature value in today's two-way market. And the 3000S is packed with standard features. Features like Spectrum Analyzer, CTCSS Tone Display, Oscilloscope, RF Sweep, FM Markers, Zero Beat, Audio Synthesizer with burst and Audio Voltmeter.

Whatever your needs, on the bench or in the field, the CT Systems 3000S Service Monitor is tough enough to provide you with years of dependable service.

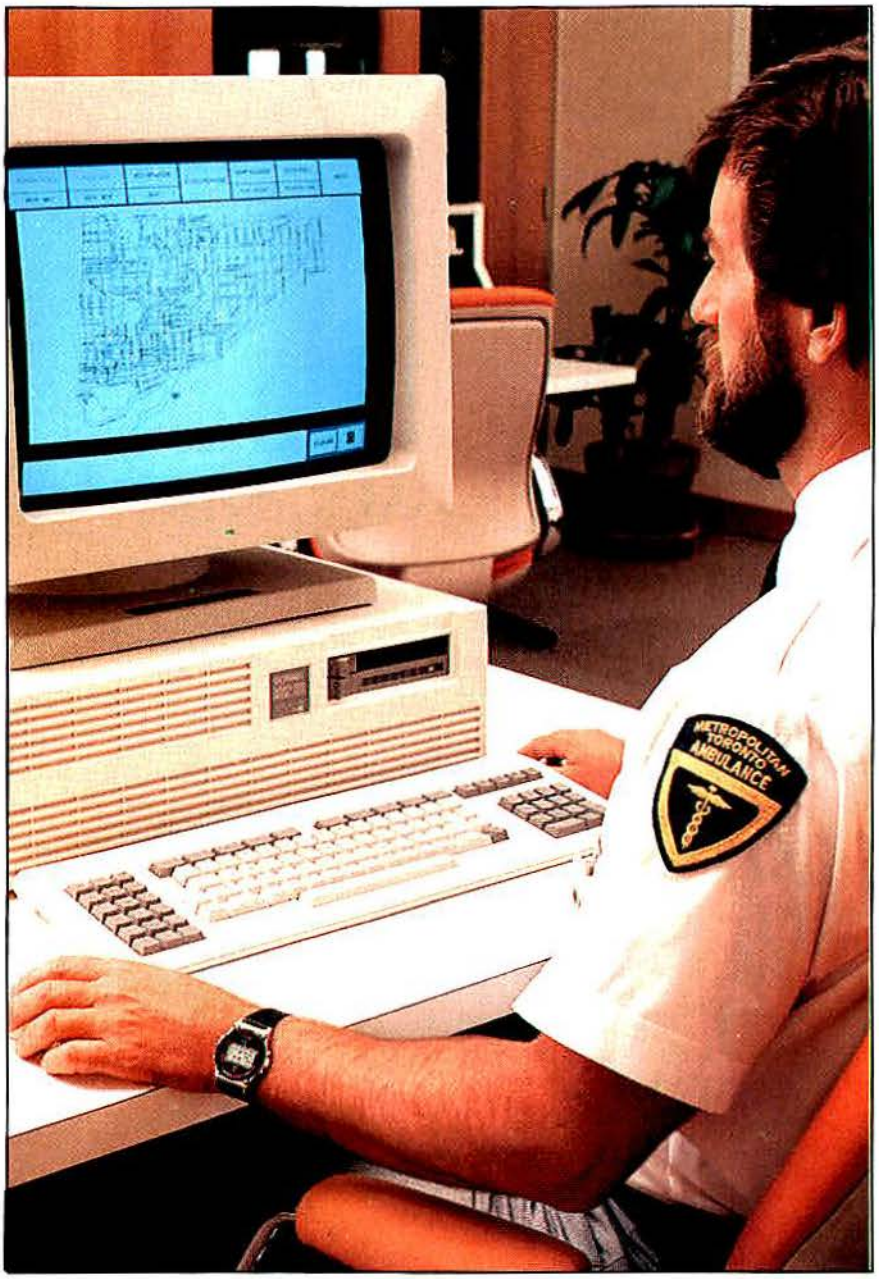
Now, we could go on but we think that would be cruel. Just give us a call in the mourning, or anytime, for full specifications.

CT SYSTEMS, INC.
5245 HORNET AVE.
P.O. BOX 470
BEECH GROVE, IN 46107-0470
800-245-6356
317-787-5721

Circle (11) on Fast Fact Card

Designing and implementing automatic vehicle location

Automatic vehicle location system team members explain the criteria used to develop specifications for the Toronto system and how it works. A status report and problem-solving examples are included.



By Dan Perlstein and Mario Cid Fernandez

The Metropolitan Toronto Department of Ambulance Services is completing its installation of a pilot automatic vehicle location system (AVLS). The AVLS system is designed to give dispatchers a tool for monitoring in real time the movement and status of the city's emergency vehicle fleet. (See Photo 1 on the right.).

Tool for growth management

The department is one Canada's largest ambulance services. It covers 400 square miles with a population of nearly 3 million. It responds to 1,200 calls per day, nearly a half million calls per year.

The fleet includes as many as 70 basic life support (BLS) vehicles, eight paramedic crews, two multipatient buses and other support and mobile communications vehicles. The average response time for BLS units is less than six minutes. For a paramedic unit, the response time is less than four minutes. During the last seven years, call load growth has averaged 15% annually.

In 1984, the department began examining ways to cope with projected growth. Options included vehicle location systems. The emerging technology held great promise for improving fleet management: If the real-time locations of each ambulance could be monitored at a central location, the fleet could be

Perlstein is chief engineer, communications division, department of ambulance services, municipality of metropolitan Toronto. Fernandez is marketing and sales manager of Nav-Com, Deer Park, NY.

managed more effectively.

Along with the status and position of available ambulances, incident locations could be displayed. A tight correlation could be generated between outstanding calls and available ambulances.

The department wanted to test other possibilities, such as a reduction of response time, better supervision, an improved status reporting system and full data transmission.

Investigation revealed several approaches for determining the locations of moving vehicles, communicating position data to the control center and displaying that data for dispatchers and supervisors. It was necessary to define the specifications for Toronto around the city's unique requirements.

In late 1987, the department contracted for the development and installation of a pilot AVLS. Objectives of the project were:

- to test the ability of hardware and software to compute the location of a vehicle with an error rate of less than 2% of the distance traveled, not exceeding 600 meters in any case.
- to examine various useful ways to display maps on screens for the dispatchers.
- to test voice and data compatibility on a radio channel.
- to decide on the best adaptive polling algorithm.
- to test the system's ability to handle advanced status reporting (including time tags that reveal when status changes occurred, not the time the data transmission occurred).
- to examine the required degree of integration between the AVLS and the computer-aided dispatch (CAD) system.
- to give dispatchers and ambulance attendants an opportunity to see the system in operation, to use it and to become familiar with its result.

Operational specifications initially developed by the department were further refined and updated by a joint team. Installations began in early 1988. The system soon enters its operational evaluation stage.

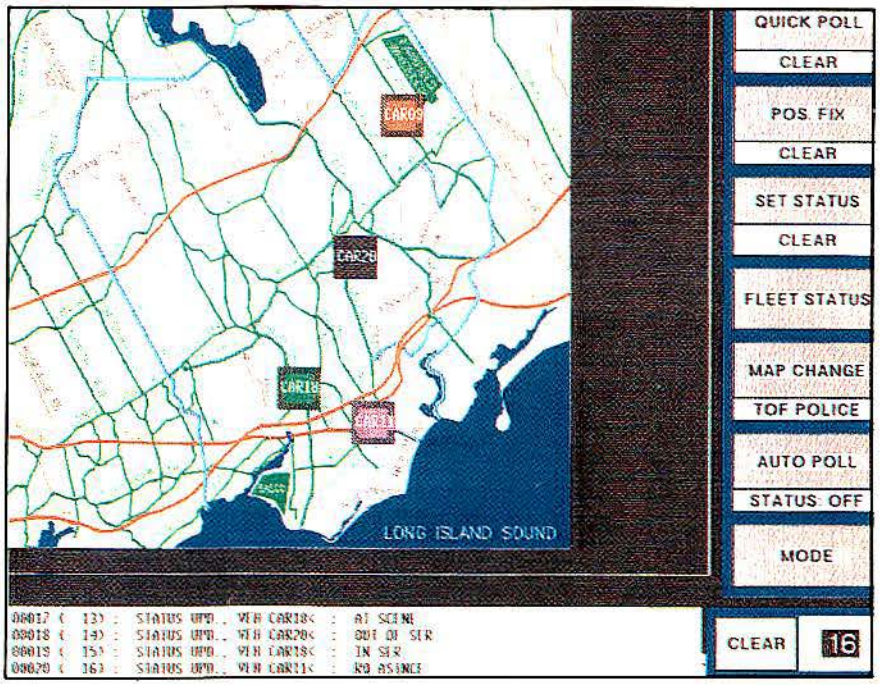


Photo 1. The automatic vehicle location system display screen includes a map, control menu and 'informer window,' which shows real-time status messages. Color distinguishes regions and vehicle status. Region numbers, such as R5, identify other available maps that may be called to 'zoom in' on a region with a detailed street map.

System overview

The system includes three basic elements:

(1) the vehicle navigation subsystem.

(2) the data transmission subsystem.

(3) the display subsystem.

Linking all three is the main processor unit, which controls the polling of the vehicles and data transmission and reception. The main processor unit also drives the graphics software that in turn controls displays on screens in the control center.

Base station

An Apollo Domain DN3000 microcomputer at the dispatch control center serves as the main workstation and processor unit. (See Figure 1 on page 14.) The hardware includes a high-speed, 32-bit processor, floating-point math co-processor, eight megabytes of memory and a 155 megabyte fixed disk drive.

The system runs under the advanced multitasking Aegis operating system and has built-in networking capability. It can support the UNIX operating system, too. (See Figure 2 on page 16.)

The computer drives a series 3000 color graphics monitor, which provides resolution of 1,024 × 800 pixels and can display as many as 256 colors at once. Domain Screen Manager software supports pop-up windows in the screen to display text and graphics simultaneously.

The computer screen shows large color digital road maps showing the most recent location for each vehicle. Vehicle icon colors indicate status, such as "on-call," "available at scene" and "return to station." The dispatcher can view the entire service area or can call up larger-scale maps for a closer look at a particular zone in greater detail.

Pop-up windows are used to display menu prompts, as well as alphanumeric status information, messages and other data. The dispatcher can call up a summary of locations and status for any vehicle or group of vehicles quickly. A "mouse" or trackball is used as the primary operator control, reducing keyboard entries.

Communications link

Vehicle positions and status are updated using data inputs automatically transmitted from processors in the vehicles. At intervals, the central computer initiates a short databurst addressed to a specific vehicle. The vehicle unit returns formatted position and status reports. The entire polling and response sequence is computer controlled and requires no action on the part of the driver.

Adaptive polling software governs the

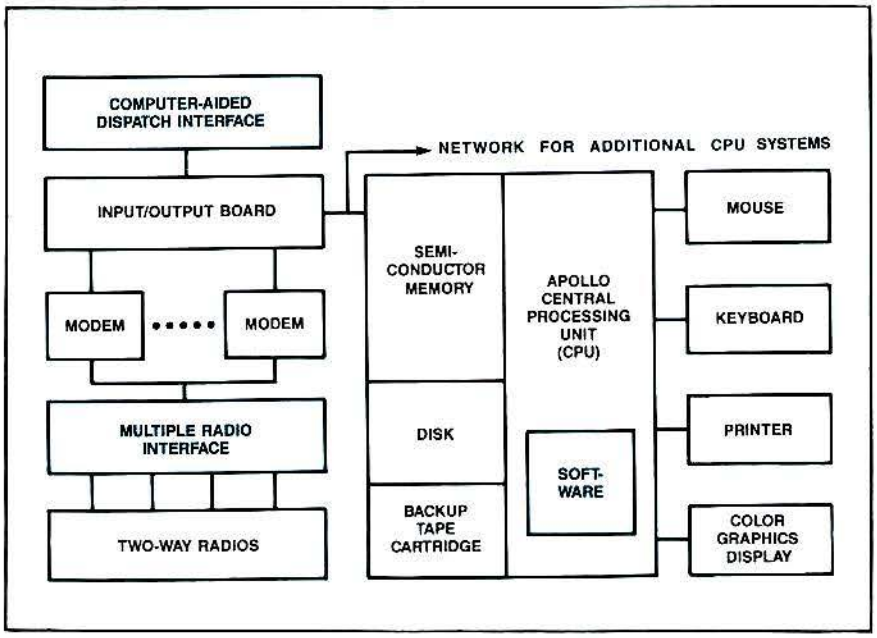


Figure 1. System block diagram (base). An Apollo Domain DN3000 microcomputer at the dispatch control center serves as the main workstation and processor unit. The hardware includes a high-speed, 32-bit processor, floating-point math co-processor, eight megabytes of memory and a 155 megabyte fixed disk drive. Highlighted system elements are customized for each installation.

polling sequence for the vehicles. The frequency with which any given vehicle is polled varies as a function of its most recent status. Thus, a vehicle available for calls is polled more often than one already dispatched to a call.

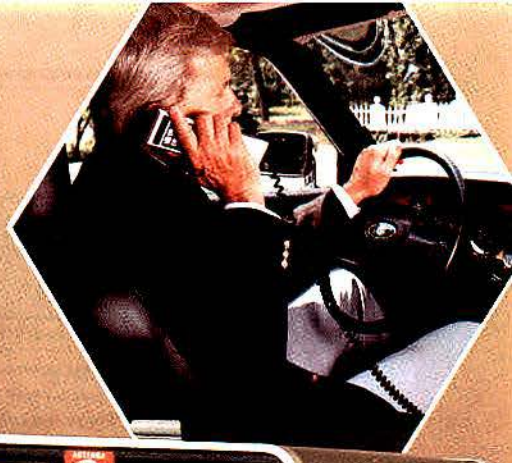
The dispatcher can override the polling to request any specific vehicle's position report or to poll all the ambulances by their status automatically and quickly.

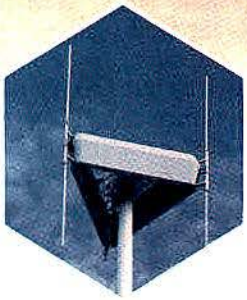
Short messages can be sent through the AVLS datalink. The driver can initiate preprogrammed messages, such as "arrived at scene" or "departed station," at the touch of a button. A special button on the driver's display console causes a high-priority emergency message to be sent to the base station.

Communications between the vehicles and base station are logged automatically onto the main computer's fixed disk drive. This log file may be used to create statistical and historical reports and printed copies.

Existing half-duplex radio channels

The ifr FM/AM-1500 with optional CELLULAR TELEPHONE TEST CAPABILITIES





Now you can retain needed service monitor functions and perform cellular mobile tests as well, all with the FM/AM-1500.

IFR offers an option to the popular FM/AM-1500 for the testing of cellular mobile telephones. The FM/AM-1500 with options 08*, 09 and 10 will facilitate the testing of cellular mobile radios in a manual test mode as well as in a cell site simulation mode.

Capabilities include:

- Manual command execution**
- Mobile and cell initiated call processing functions
- Hand-off simulation
- Automatic test
- Control unit test**
- Printer port. *(For outputting status or test results to a line printer)*

*Option 08—Installed internally within FM/AM-1500

**Per AMPS-May, 1983 specifications

the best is cost effective

ifr INC

10200 West York Street / Wichita, Kansas 67215 U.S.A. / 316/522-4981 / TWX 910-741-6952

A Subsidiary of ELECTRONICS, INC.

Circle (13) on Fast Fact Card

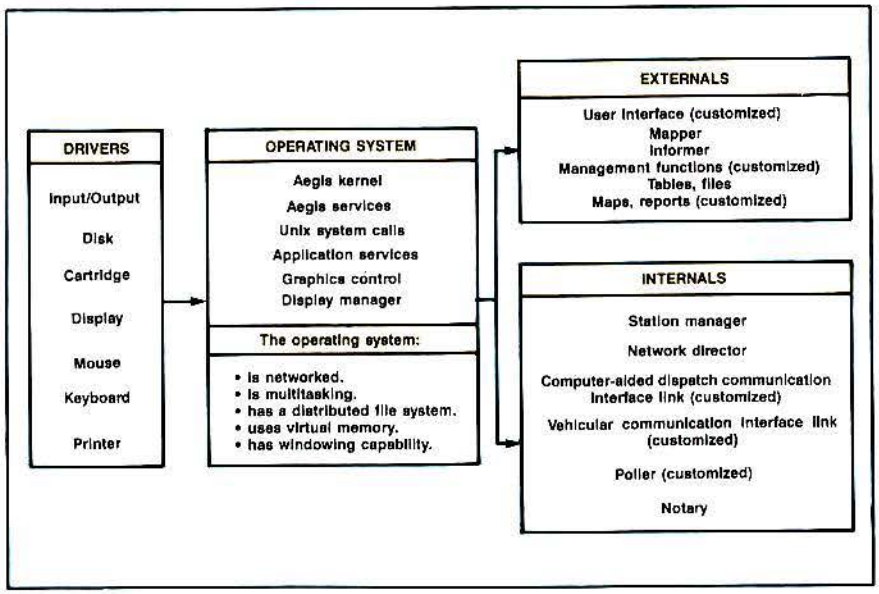


Figure 2. Modular sofware diagram. The system runs under the advanced multitasking Aegis operating system and has built-in networking capability. It can support the Unix operating system, too. Several elements are customized for each particular installation.

are used for the AVLS, eliminating the need for new frequency allocations and licenses, as well as new communications equipment. Early tests have shown voice and data to be compatible on the same channel. The compatibility issue is important and will be tested thoroughly during the pilot project.

Vehicle equipment

Each vehicle is fitted with a compact navigation processor, which determines its geographic position by measuring the distance and direction traveled from a known starting point. (See Figure 3 on page 18.) Speed and heading sensors provide raw data automatically. Speed is measured by a transducer connected to the vehicle's speedometer. Direction information is supplied by an electronic flux-gate compass.

Processors

The vehicle equipment package includes a communications processor, which controls digital data exchange with the base station. The processor constantly listens for messages containing its exclusive address ID and coordinates the response.

The navigation and communications processors function automatically and are mounted in a closed compartment. A driver display and control panel is mounted on the instrument console. It includes an alphanumeric display and a set of dedicated, preprogrammed function buttons.

Free-formatted messages from the dispatcher are displayed automatically on the display and control panel as they are received. Normally, the most recent message is shown, but the operator can view as many as 10 previously received messages.

Dedicated buttons can be used by the driver to initiate preprogrammed messages to the dispatcher. Other buttons are used to request a voice call from the dispatcher, acknowledge receipt of a text message from the dispatcher, view previously received messages and other functions.

Vehicle location alternatives

A critical element in overall AVLS performance is the methodology used to determine vehicle locations. In developing system specifications, the department examined four alternative technologies for vehicle position-fixing:

- Loran-C (*Lo*ng *Ra*nge *N*avigation)
- Global Positioning System (GPS)
- Signposts
- Dead reckoning

GPS and signposts were rejected.

GPS is a satellite navigation system being deployed by the U.S. Department of Defense. It will not be fully available for civilian navigation until 1990. Although GPS is not currently practical, it was deemed desirable that the system should make provision to be upgraded to GPS later.

Signposts are low-powered radio transmitters placed around the service area to emit signals to passing vehicles. The location thus recorded by the vehicles is transmitted to the base station. Signpost technology was evaluated as too expensive to be practical for Toronto because of the large number of signposts required.

Loran-C is a marine radionavigation system used in some other cities for AVLS. But the 100kHz Loran-C signals do not propagate well in downtown Toronto. Signal blockage and distortion in narrow streets bounded by tall buildings is compounded by the overhead trolley wires. The wires act as a Faraday cage that blocks the low-frequency signal.

Automatic dead reckoning

For the foregoing reasons, the department elected to use a system based on dead reckoning. Dead reckoning is a concept familiar to mariners and aviators, though it is not well known to land mobile two-way radio operators.

Dead reckoning refers to a method of projecting a moving vehicle's location as a function of direction and speed traveled since the last known position. The term is borrowed from marine navigation.

Traditionally, a mariner could determine his boat's position only at intervals, using "fixes" taken from celestial observations, visual piloting or electronic aids. The navigator plots the position on a nautical chart and draws a line representing the vessel's intended track from that point.

At any time, the navigator may refer to the chart, compass, speed log and clock to determine the vessel's position as a function of direction, speed and elapsed time since the most recent fix.

Today, navigation by dead reckoning often is automated by feeding digital indications of speed and heading into a processor that converts the vectors into an x-y grid. Normally, geographic position coordinates are expressed in latitude (the y-axis) and longitude (the x-axis).

The accuracy of an automatic dead reckoning system is cumulative. It depends on two principal factors:

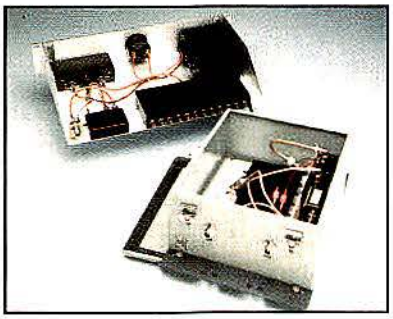
CELWAVE Quality:

We prepare you for the shock.

The chances of a site taking a direct hit from lightning are too good for comfort. Sooner than later, it's going to happen.

That's why Celwave uses six surge suppressors in its tower amplifiers and six more just like them to protect signal energy entering the base station.

Maybe that sounds overprotective, but those suppressors are part of complete receiver/multicoupler systems that can satisfy 80% of todays multichannel needs right off the shelf. Systems that are precisely designed with attention to detail.



For example, we take site noise into consideration because a high gain amplifier amplifies site noise. We include the preselector filter and the multicoupler amplifier in the package. Not all manufacturers do. Our systems are easily expanded in the field to 64 channels using nothing but a Phillips head screwdriver (not included in the package) and an instruction book (included).

Except for the screwdriver, Celwave omits nothing with its receiver/multicoupler systems to protect you from future shock. And to make sure you have everything to gain.

CELWAVE

CELWAVE, Route 79, Marlboro, NJ 07746. Toll free 1-800-321-4700. In New Jersey 201-462-1880. Telex 494 4313 CEL NJ. FAX # 201-462-6919.

GSA# GS00K88AGS0718

Circle (14) on Fast Fact Card

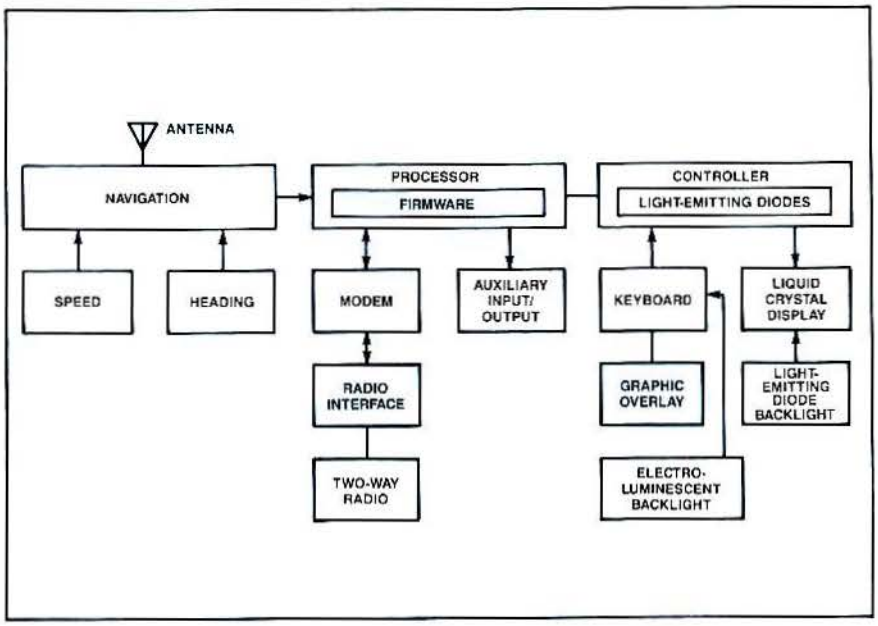


Figure 3. System block diagram (vehicle). Each vehicle is fitted with a compact navigation processor, which determines its geographic position by measuring the distance and direction traveled from a known starting point. Speed and heading sensors provide raw data automatically. Free-formatted messages from the dispatcher are displayed automaticaly on the display and control panel as they are received. Highlighted system elements are customized for each installation.

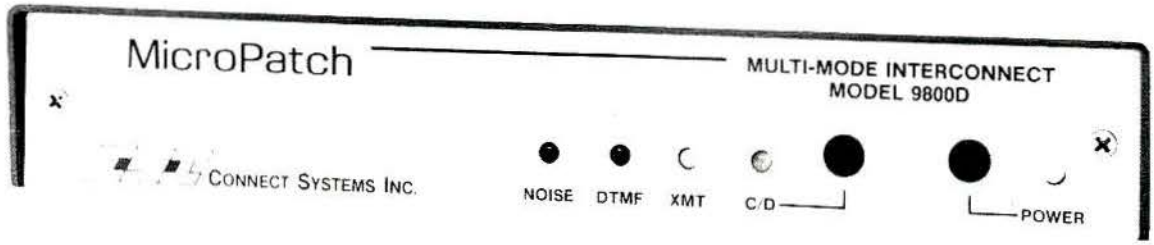
- the distance traveled since the most recent fix.
- the accuracy of speed and heading measurements between fixes.

The accuracy of a position derived from dead reckoning declines as a function of distance traveled. In Toronto, it was found that the maximum acceptable error is 2% of the distance traveled, and in any case no more than 600 meters.

It was therefore necessary to provide a method of recalibrating the vehicle navigation processor with position updates at frequent intervals. Frequent updating is accomplished by providing, as often as possible, a new reference point, such as ambulance stations and emergency wards at various hospitals. Whenever an ambulance stops at one of these reference points, the system position is updated automatically to its coordinates.

To further improve navigational accuracy between station updates, the vehicle processing unit includes a small receiver that accepts telemetry signals from the U.S. Transit satellite system.

WHAT COMPETITION?



ALSO AVAILABLE RACK MOUNTED

"MICROPATCH" is light years ahead of all other interconnects with powerful features such as a 90 number autodialer and eight user selectable operating modes . . .

1. **VOX control station patch**
2. **Sampling patch (VOX enhanced)**
3. **Duplex base station patch**
4. **Duplex repeater patch**
5. **Repeater controller with duplex patch**
6. **Dial-up remote base**
7. **Dial access paging terminal**
8. **Talk back paging terminal**

Our new 9800 is the first phone patch ever offered that gives you the selection of sampling simplex, VOX simplex and duplex operation . . . all in one unit!

In addition, a built in repeater controller will convert any receiver and transmitter into a CTCSS or carrier operated repeater. With duplex patch of course.

Several **tone signalling** software options are available **(DTMF is standard)** that allow the 9800 to be used as a **dial access paging/talk back paging terminal.** Or the tones can be used for **mobile to mobile** and land to mobile **selective calling** in phone patch applications.

The 9800 also provides complete **remote base** capability extending the use of the base station or repeater to any telephone.

The built-in **90 phone number auto dialer, last number redialer** and manual dialing are converted to **regenerated tone** or **pulse** as required.

Any preselected number can be automatically dialed by pressing the MIC button five times. When finished, five more presses causes disconnect. Thus allowing non DTMF equipped radios to dial a specific number.

Mathematical software **algorithms constantly check** the phone line audio for the presence of unwanted **dial tones, busy signals** and other **call progress tones. Automatic disconnect** occurs rapidly.

CW ID and many other features are fully user selectable/programmable using the **internal keyboard and display.** Line prompts and error messages make program selections a snap. The 90 number autodialer can be programmed over the air or with the internal keyboard.

Space does not permit telling the whole story. Please contact CSI today to find out more about the most incredible phone patch ever created!

OPTIONS

Signalling software
- 38 call CTCSS
- 1000 call two tone
- 1000 call 5/6 tone

Plug in boards
- CTCSS board (Decode/encode for repeater/patch modes)
- Electronic Voice Delay (Prevents word clipping in VOX mode)

60 DAY RETURN PRIVILEGE
ONE YEAR WARRANTY

CONNECT SYSTEMS INC.
23731 Madison St.
Torrance, CA 90505
Phone: (213) 373-6803

IN CANADA:
CARTEL ELECTRONIC DISTRIBUTORS
(800) 663-0070

INTERNATIONAL SALES:
JESCOM COMMUNICATIONS INTERNATIONAL, INC.
Phone (415) 574-1421

The vehicle's position is recalculated automatically whenever a Transit satellite rises above the horizon.

The second source of error is bias in the vehicle's heading and speed indicators.

The speed measurement is fairly simple. It is merely necessary to take a digital reading from the vehicle's speedometer.

The heading measurement is more difficult. The system uses an electronic flux-gate compass, which contains two coils placed at a 90° angle. When a current is induced to flow in these coils, the vehicle's heading can be measured as an angle relative to the earth's magnetic field.

The problem is that land vehicles are made primarily of steel. Within the vehicle body are hundreds, if not thousands, of magnetic dipoles, each creating a local magnetic field much stronger than the earth's.

Vehicles also contain masses of soft iron that warp the earth's magnetic field measurably. Moreover, in an urban environment, buildings, underground structures, bridges and other man-made steel objects cause further magnetic abberations. Another source of interference is dc-powered trolley or train lines. In emergency vehicles, dc-powered accessories, such as flashing lights and siren speakers, also create magnetic interference.

The second source of error is bias in the vehicle's heading and speed indicators.

Many of these problems can be alleviated by carefully placing the flux-gate compass. The best location for the compass in most vehicles is 10 inches or more above the vehicle roof in a position near the rear center or rear side.

Interference from roof-mounted dc loads (for example, sirens and lights) can be kept to a minimum by running a twisted pair of wires to them as power leads rather than by running a single wire with chassis return.

The flux-gate compass can be calibrated automatically. The vehicle processor measures the ellipticity of the magnetic field as the vehicle rotates through different headings and also measures the offset of the ellipse. The processor uses this data to separate the vehicle effects from the earth's magnetic field and compensates for the difference.

A land vehicle's magnetic signature is unstable, so the compass must be recalibrated at intervals. Large magnetic fields through which the vehicle passes or mechanical work performed on the vehicle can change its magnetic signature.

Lesser, but measurable, magnetic changes are caused by vibration, shock,

Only one battery company offers all these. (And more than 1200 others.)

Batteries shown here were all introduced during the past year.

When you need a replacement battery, you don't have time to check around to see who has it.

This is why, during the past year alone, we've introduced more new replacement portable radio batteries than our competition, combined. Quite a feat when you consider we refuse to introduce a new battery until we're sure it meets, or exceeds, original specifications.

Batteries now available.

Portable Radios
- E.F. Johnson LX
- G.E. MPD, TPX, PLS Series
- Icom H&U Series
- Kenwood TK200, TK300 Series
- Midland 70-155 Series
- Motorola HT600 Series
- Motorola MT1000 Series
- Motorola MTX800 Series
- Motorola MX300 Series
- Motorola MX300R
- Motorola Radius P10, P50 (Low Power)
- Motorola Radius P50 Plus, P50 (HighPower)
- Motorola Radius P100 Series
- Motorola Radius P200 Series
- Motorola Saber Series
- Motorola STX Series
- Pace Landmaster
- Philips Pye PF/PFX
- Shinwa UR50P, UR40P, SH503KG
- Standard HX400 Series
- Telemobile
- Yaesu FTC2003

Portable Cellular Phones
- Motorola 6000, 8000 Series
- Motorola 9500 Series
- Nokia-Mobira Cityman

Pagers
- Motorola Sensar

Free catalog, call 800-247-1821

Alexander® Batteries

Circle (18) on Fast Fact Card

temperature changes, body work and loading or unloading ferrous materials from the vehicle. Minor, but still measurable, changes occur during overnight parking.

It must be feasible to recalibrate the flux-gate compass frequently. Methods have been developed to recalibrate the compass automatically and continuously during normal driving situations.

Other sources of error

Actually, there is a third source of error in AVLS accuracy, no matter what technology is used for vehicle navigation. The third source is the amount of time that passes between sequential data transmissions from the same vehicle.

In other words, from the dispatcher's point of view, the position shown on the screen is the only important one. If the vehicle has traveled a long distance since its most recently reported position, the position indicated on the screen becomes inaccurate. There is little value in obtaining location accuracies of one city block (600 feet) if the interval between transmissions is, for example, three minutes. In a metropolitan area, an ambulance can travel 1½ miles in three minutes.

Adaptive polling software reduces to a minimum the problem of elapsed time: The computer polls more often those vehicles most important to the dispatcher, and others less often.

A less obvious source of error lies in the map display. Vehicles necessarily are shown by symbols much larger than they would be if drawn to the map scale. In the Toronto AVLS, a high-resolution monitor (1,024 × 800 pixels) displays an area roughly 29 × 16 miles. The minimum acceptable size of a vehicle symbol is 15 × 15 pixels. On the map, the symbol covers an area that represents 2,337 × 2,337 feet.

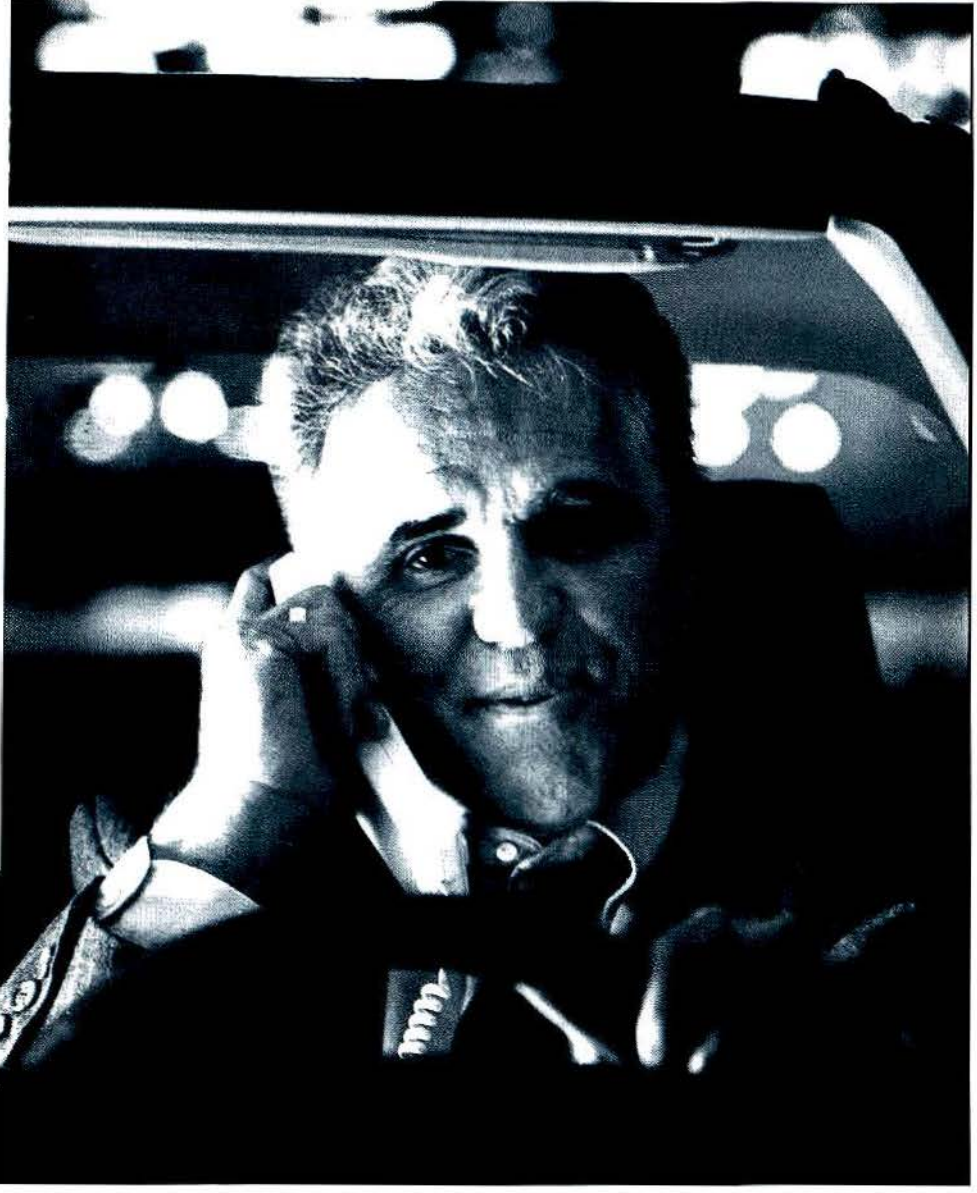
System status

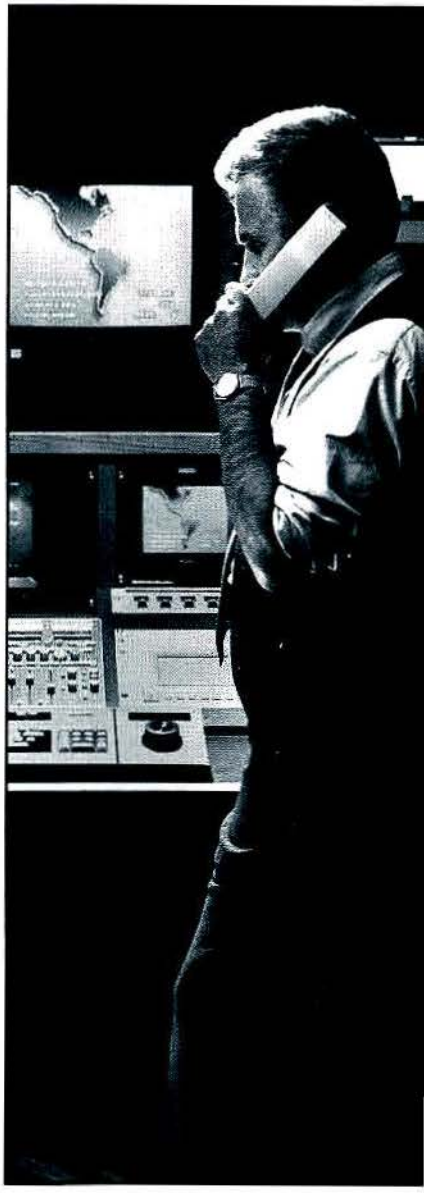
Pilot system installation presently is being completed, and the system is becoming operational. Phase 1 of the system covers southeastern metropolitan Toronto, an area with the highest level of calls during the day. It includes downtown Toronto, the major general hospitals and provincial and municipal government buildings. Twenty vehicles operate on the system.

During the next 12 months, the system will be evaluated for:

- usefulness to dispatchers.
- ability to attain consistent, acceptable accuracy.
- ease of conversion to GPS when it becomes available.
- ease of maintenance.

The system is open-ended, in the sense that it can be expanded and upgraded easily. The Apollo Domain computer's built-in networking capability will make it easy to add more dispatcher workstations or to integrate a supervisory terminal in a different location. The system can retransmit vehicle status and position information on a serial RS-232C port to the computer-aided dispatch (CAD) computer to exchange information between the two systems.





Larsen keeps you in the driver's seat.

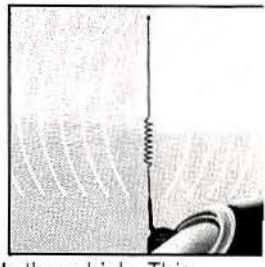
In today's marketplace the ability to communicate quickly and clearly is critical.

That's where Larsen means business.

Larsen offers a full line of Kūlglass™ Antennas* that mount quickly and easily. Their low impedance power transfer provides top performance under all conditions.

With Larsen, business never sounded so good.

LOW IMPEDANCE DESIGN MAKES FOR HIGH PERFORMANCE.



The key to Larsen's high performance lies in placing the antenna tuning assembly on the outside of the glass, with no tuning inside the vehicle. This allows a low impedance power transfer through the glass.

By utilizing an external tuning network, the Kūlglass™ series uses full length radiating elements for peak performance.

* Larsen Kūlglass™ Antennas, patent pending.

Larsen Antennas

IN USA: Larsen Electronics, Inc., 11611 N.E. 50th Ave. P.O. Box 1799, Vancouver, WA 98668 206-573-2722. Toll free order line: 1-800-426-1656 In Washington State 1-800-562-1747. Telex: 15-2813 LARSENELC VANC

IN CANADA: Canadian Larsen Electronics, Ltd., 149 West 6th Avenue, Vancouver, B.C. V5Y 1K3 604-872-8517 Toll Free 1-800-663-6734 Telex: 04-54666 CDN LARSEN VCR

Circle (20) on Fast Fact Card

Tracking 64,000 vehicles with meteor-scatter radio

VHF signals bounced from meteor trails form the backbone of a nationwide vehicle tracking and radio communications network designed to serve the trucking industry. Who needs satellites? Use nature's 'transponders!'

By Kathy D. Mickelson

Billions of dust-sized meteors slice through the atmosphere each day, creating trails of ions in a region 53 miles to 72 miles above the earth. The short-lived ion trails reflect bursts of radio signals, especially VHF lowband signals. Meteor trails are so common that they provide dependable, long-range communication.

The exotic propagation mode—*meteor scatter*—allows a single VHF lowband base station to cover a radius as great as 1,200 miles, although 800 miles represents reliable coverage. Transtrack is building a network of five base stations to cover the continental United States. Its headquarters and network operations center are in Marion, MA. (See Photo 1 below and Photo 2 on page 26.)

Photo 1. Transtrack headquarters in Marion, MA, occupy a historic building erected by Marconi to house shortwave transmitters.

Transtrack's marketing efforts focus on regional and nationwide trucking companies. Its system automatically determines and reports truck positions. The system allows two-way data communication with the drivers. The five base stations' coverage areas overlap to offer redundancy. (See Figure 1 on page 26.)

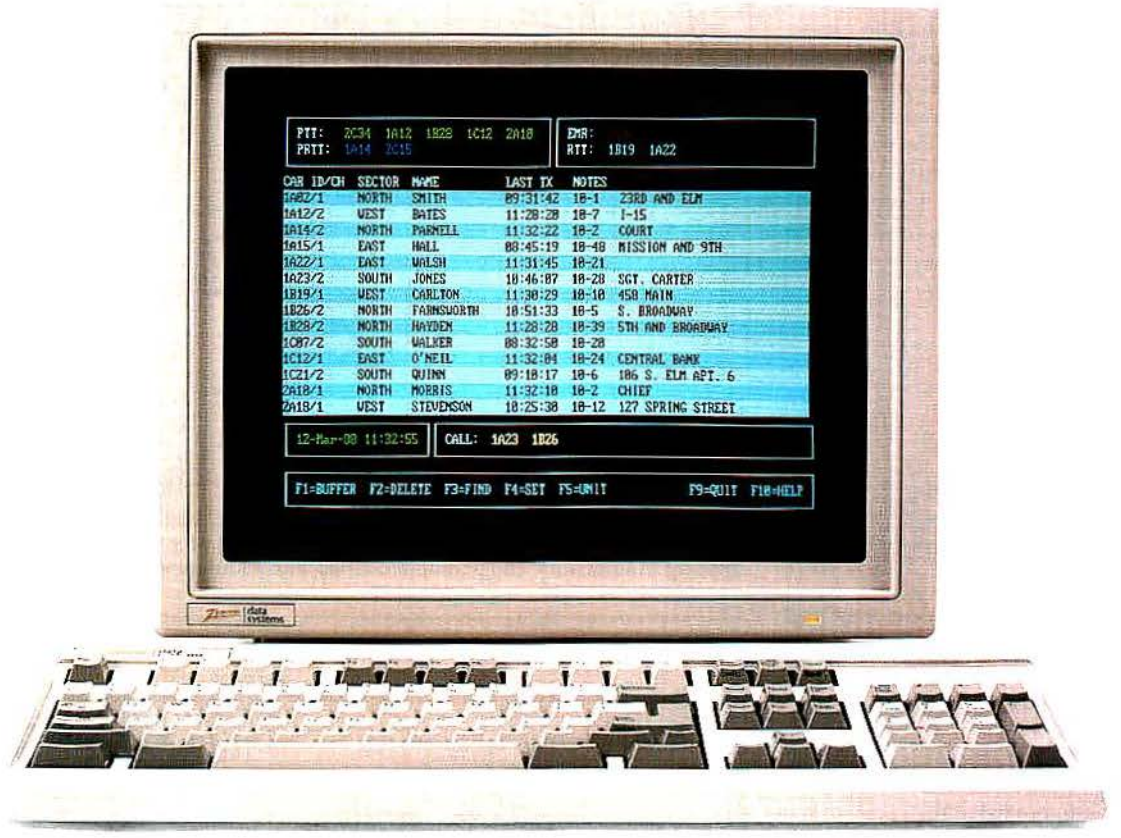
Transtrack's system has improved upon government and military agencies' meteor-scatter communications uses, which have been developing since the 1950s. Advancements made in computer and solid-state technology during the last few years have reduced equipment costs. These cost reductions led to an application in nationwide vehicle tracking and data communications.

Meteor trails replace earth-orbiting satellites as relay points. Each trail lasts a few milliseconds to several seconds. During the brief interval, as many as 32 American Standard Code for Information Interchange (ASCII) characters can be sent per message packet. Sometimes, more than one packet may be sent via a single meteor trail. The capacity is sufficient to track vehicles and to transmit and receive information via high-speed digital equipment. (See Figure 2 on page 26.)

To send longer messages, Transtrack's system uses a sequence of meteor trails. Long messages are pieced together at the network operations center and at the vehicle to display alphanumeric text messages to drivers and dispatchers. The system averages about 10 connec-

Mickelson is associate editor of Intertec Publishing's *Video Systems* magazine. When this article was written, her responsibility included *Mobile Radio Technology*.

Can You Really Identify Who's Transmitting?



DIGITAL UNIT IDENTIFICATION is the industry standard adopted by General Electric and Motorola to positively identify mobile and portable transmitters in public safety, fire, government, business and industrial radio systems. Only Coded offers full compatibility with these standards.

SUPERIOR SIGNALING RELIABILITY

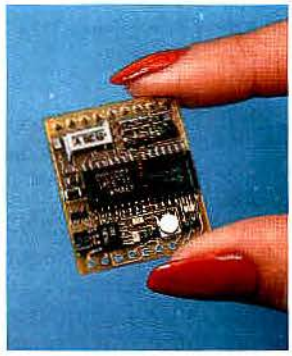
Digital PSK modulation is employed in combination with powerful error detection and correction protocols to provide superior accuracy and reliability. Coded's automatic transmitter identification encoders and decoders typically exceed 99.99% signaling reliability at signal-to-noise ratios too low to support effective voice communications.

FAST AND ACCURATE

In less than a third of a second the entire four digit identification burst is transmitted, received, error detected, corrected and displayed. This is less time than it takes to send four simple DTMF tone digits without the benefits of error detection and correction.

COMPLETE SYSTEMS CAPABILITY

Coded's full line of products are compatible with existing radio equipment to meet the needs of both large and small systems. Our subminiature encoders are designed to fit the smallest portable and mobile equipment and are easily installed. Coded's status display system, shown above, provides dispatchers with an efficient cost effective solution for fleet status monitoring. Our system controllers are designed to interface with complex CAD systems and can accommodate the largest public safety fleets.



FIND OUT WHY CODED IS BEST

Let Coded identify solutions for your requirements and discover why Coded is the leader in transmitter identification products.

Coded communications

2375 Camino Vida Roble, Carlsbad, CA 92009
Nationwide 800 228-6367 / California 800 325-0147
TELEPHONE 619 431-0077

Circle (21) on Fast Fact Card

tions per hour with trucks that drive normal working routes.

Meteor vs. satellite

Meteor scatter communication compares favorably with satellite transmission:

- *Cost*—Expensive satellite lease agreements are not needed.
- *Risk*—Meteor trails always are available; communication satellites may fail and eventually must be replaced.
- *Privacy*—Meteor trails occur at random intervals and in random positions. Reflected radio signals illuminate

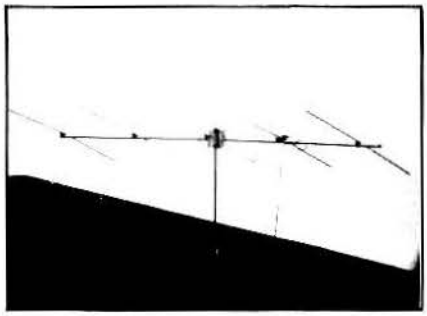


Photo 2. Above the Transtrack headquarters building is a lowband VHF yagi used in early testing of meteor scatter communications.

15- by 30-mile elliptical patterns on the Earth's surface. Propagation lasts an average of 200ms. The coverage pattern travels at 70km—twice the speed of the meteor. According to Transtrack, unauthorized interception is difficult. Moreover, transmissions are coded.

To intercept over-the-air mobile transmissions would require base station equipment similar to that used by the network's base stations, or the extraordinary luck of being within the relatively short groundwave range of a mobile transmitter.

But a receiver placed within 20 miles of one of the network's high-powered base stations could intercept base transmissions easily.

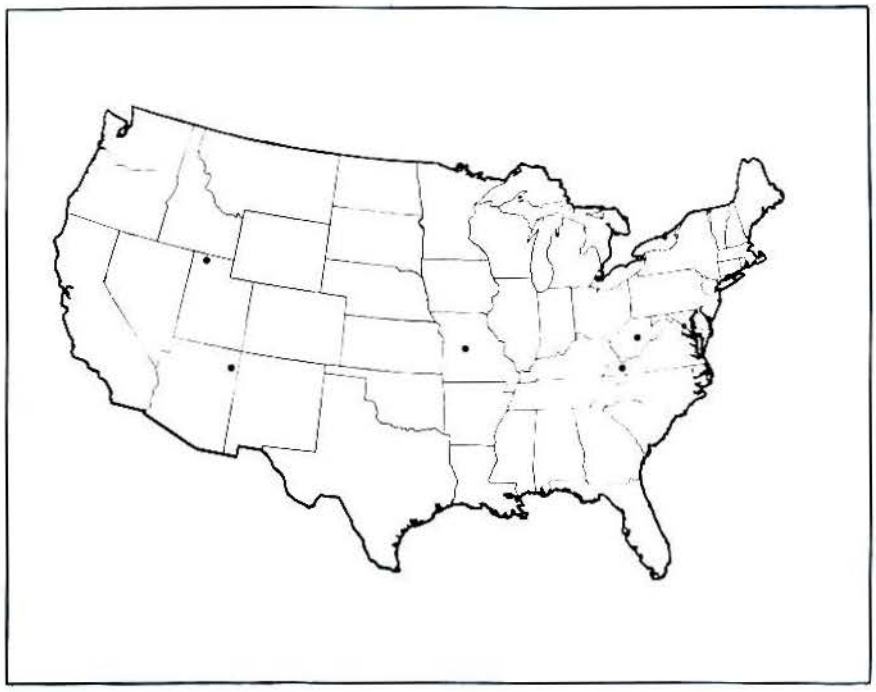


Figure 1. Five base stations in West Virginia, Missouri, Arizona, North Carolina and Utah cover the continental United States. Each base station covers a nominal 800-mile radius, offering the network considerable overlap and redundancy.

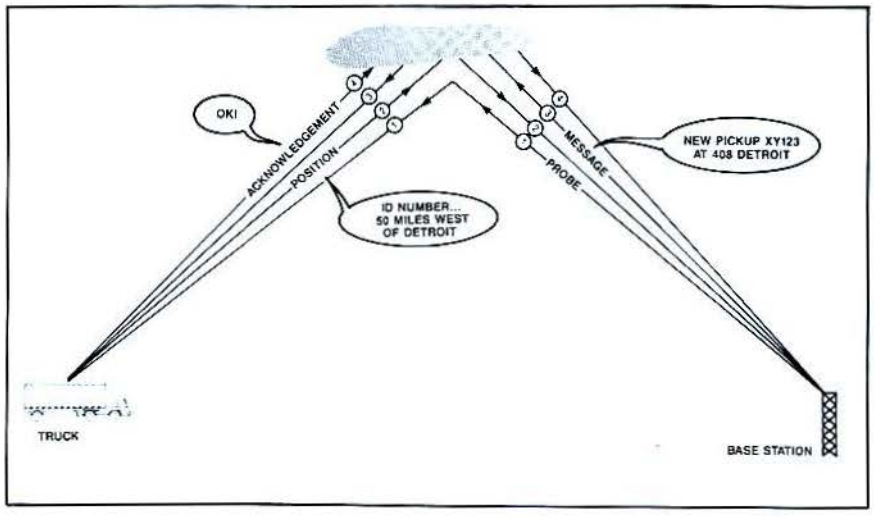


Figure 2. In 150ms, relayed via an ionized meteor trail, the base and mobile exchange (1) probe signal; (2) truck's position; (3) message to truck; (4) message from truck to base.

FCC authorization

On Feb. 12, 1988, the FCC authorized construction and operation of the nationwide network under a business radio service license. It authorizes 64,000 mobile units for use within the continental United States.

The license waives certain FCC rules:

- It authorizes the system to be operated on motor carrier service frequencies. Motor carriers are, after all, expected to be the primary customers.
- It permits a base station power of 2,000W; the normal limit is 300W.

Transtrack designed its facilities and positioned its towers so base station transmissions will not interfere with TV reception or co-channel motor carrier licensees. (See Photo 3 on page 28.) The five base stations are in rural areas. No co-channel licensees have facilities within 175 miles of them; the placement is intended in part to prevent groundwave interference with co-channel licensees.

Potential skywave (skip) interference caused by base station signals reflected from meteor trails is minimal because meteor scatter propagation is brief. But the extent of possible skywave interference from ionospheric F-layer or sporadic E-layer propagation of base

GENERAL COMMUNICATIONS, INC.

(AUTHORIZED DEALER)

GE Mobile Communications

- Complete customer satisfaction or we will replace your radio or refund your money — guaranteed!
- General Communications has the *largest* inventory of General Electric radios and will guarantee the *lowest prices*!
- Before you buy from just anybody, buy where you can depend on quality sales and service!

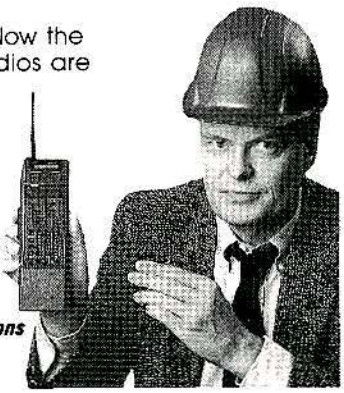
YOUR #1 GENERAL ELECTRIC SUPPLIER

"I'm tough to satisfy. Only GE gave me satisfaction— guaranteed!"

SATISFACTION GUARANTEED

"My GE Dealer told me I had up to 90 days to decide if my GE two-way radio met my expectations. If I had a problem, he said he'd replace the radio, or give me my money back. Now that's what I call a good deal"

Satisfaction Guaranteed. Now the highest quality two-way radios are backed by the strongest customer assurance program.



GE Mobile Communications

MPI — PLS — MPD — MLS
PSX200 — PHOENIX — RANGR — DELTA — MVS
MCS — MASTR II — TPX — TMX — CF3000XR

CALL TODAY FOR IMMEDIATE SHIPMENT!

1-800-356-3200

VISA MasterCard

5157 ANTON DR. MADISON, WI 53719

Circle (22) on Fast Fact Card

Photo 3. This site on a Missouri farm is a possible Transtrack base station location. It offers ac power (overhead line), telephone service (buried cable), at least 175 miles separation from co-channel licensees and it is a mile or more from the nearest TV receiver.

station signals is unknown. Under the terms of its license, Transtrack bears the burden of alleviating interference problems.

For two years, the company operated portable base stations in Montana, Washington, Alabama, Massachusetts and West Virginia to test performance and coverage. Pilot programs have been conducted with two of the largest trucking companies in the West and Midwest.

Permanent base stations have been built that cover the region east of the Mississippi River; the rest of the base stations are being installed in a westward progression. The base stations are in West Viginia, North Carolina, Missouri, Arizona and Utah.

System configuration

Each base station is equipped with a crossed-dipole transmit antenna and four five-element receive yagi antennas. Other equipment includes an exciter, a linear amplifier, duplex filters, a receiver and a mini-computer for system

These save lives.

This saves more.

No matter what kind of emergency vehicles you are responsible for, you can save time, manpower—and money—with some help from Magnavox. Because Magnavox AVLS uses advanced navigation technology and electronic mapping to let you see your fleet at a glance, and deploy it more efficiently.

A Magnavox AVLS is integrated to your communication system. The system polls for vehicle locations silently, and automatically, reducing voice traffic while it gives you a timely, accurate picture of the disposition of your entire fleet. It uses two proven integrated positioning systems. And everything is automatic, so you can respond to emergencies faster and more efficiently.

When every second counts, you can't afford to be without a Magnavox AVLS.

To see how much the system can save you, contact Marketing Manager, NAV-COM, Inc., a subsidiary of Magnavox Advanced Products and Systems Co., 9 Brandywine Drive, Deer Park, NY 11729, Telephone (516) 667-7710, FAX (516) 667-2235.

Magnavox
Magnavox Advanced Products and Systems Company

8209/6/88

Circle (24) on Fast Fact Card

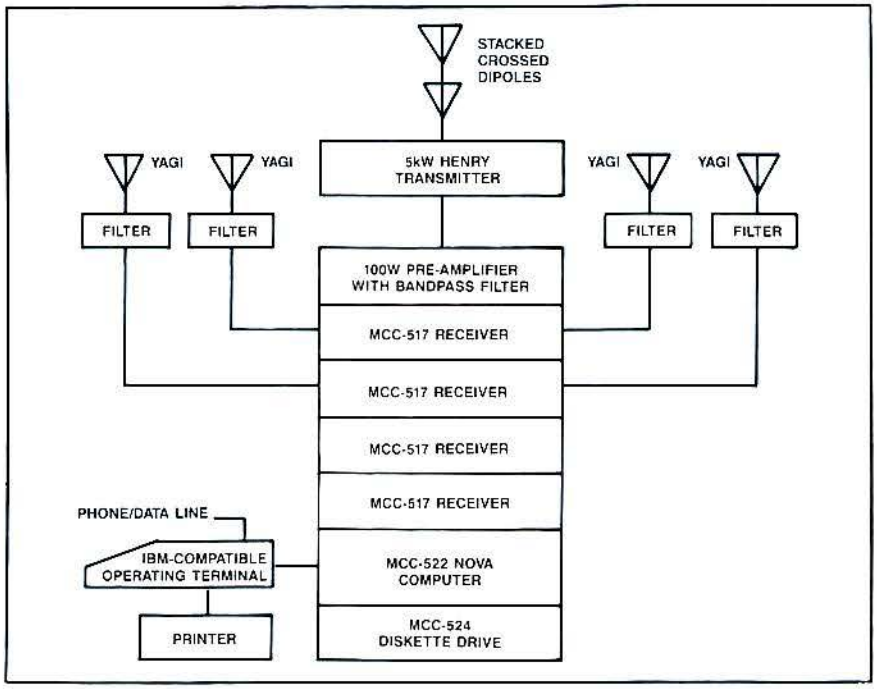


Figure 3. Each base station, in its proposed configuration, operates a 5kW lowband VHF transmitter conservatively at 2kW, feeding crossed dipole antennas. Four receivers connect to yagi antennas oriented toward different quadrants of sky.

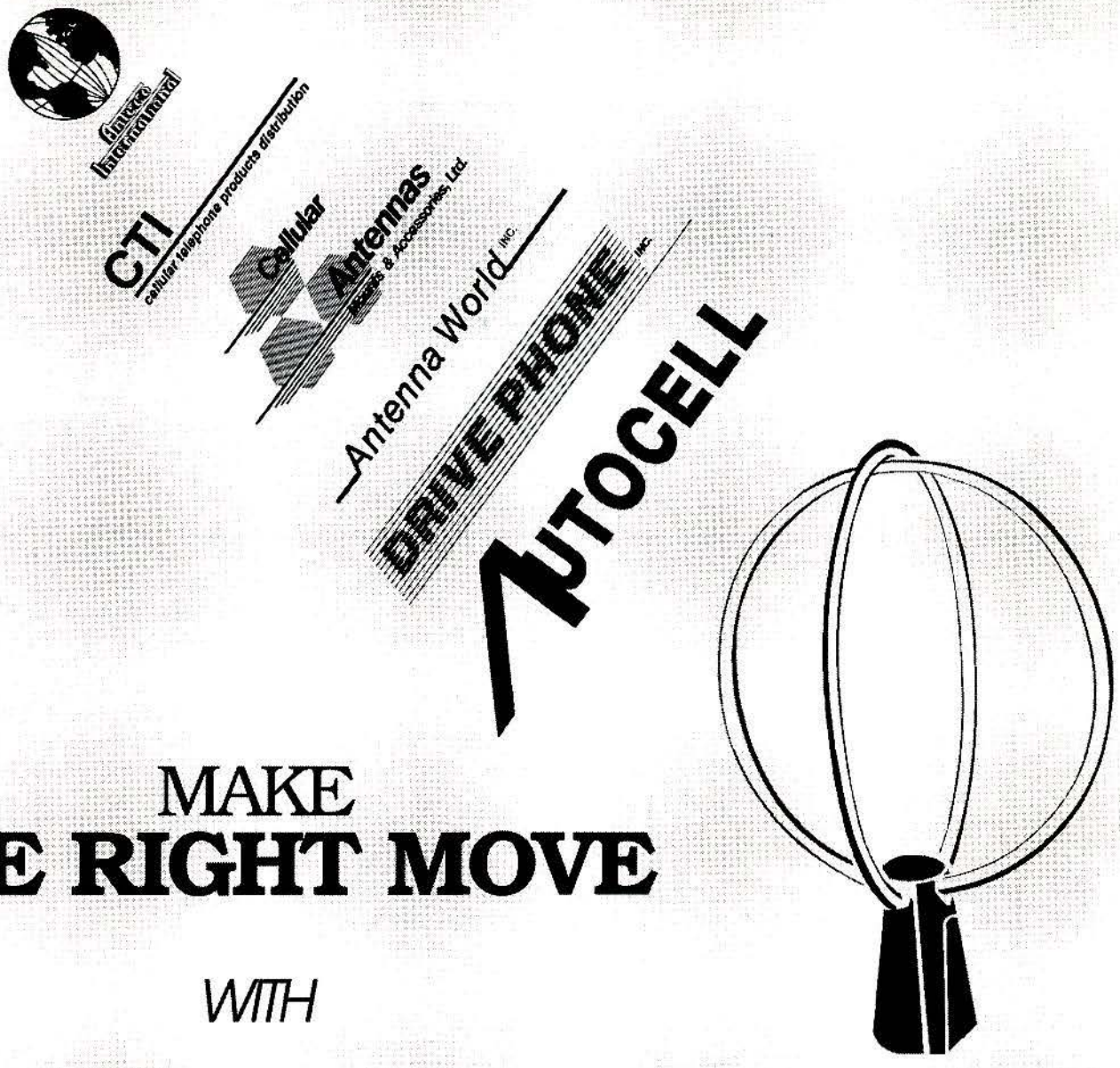
control. (See Figure 3 at the left and Photo 4 on page 34.)

Mobile units are tracked by at least one base station or as many as two or three. Each base station communicates with vehicles within a radius of 500 to 700 miles and can serve several thousand mobile units.

After receiving a transmitted acknowledgement that the base station received its message, each mobile unit automatically avoids transmitting again for a specified period controlled by the network operations center. This "sleep period" restricts network use to necessary communications because the mobile is "awakened" by outgoing or incoming messages. The "sleep period" limits potential RF interference to other users of the frequency in the area surrounding the mobile and limits potential TV interference.

Duplex mode

Communication is duplex—base stations transmit constantly on one fre-



MAKE
THE RIGHT MOVE

WITH

ALLGON ANTENN Distributors

Antenna Electronics Company
P.O. Box 14728
Fort Worth, Texas 76117
(817) 281-8403 In Texas(Call Collect)
1-800-433-7631 All Others

Antenna World
4762 S.W. 72nd Avenue
Miami, FL 33155
1-800-637-0222

Autocell
P.O. Box 92
Richmond Hill, Ontario
L4C 3R6
(416) 883-9871

Cellular Antennas
5299 W. Washington Blvd.
Los Angeles, California 90016
1-800- 634-3948

CTI
6800 Orangethorpe, #B
Buena Park, CA 90620
(713) 523-4064

Drive Phone
37 Spring Valley Avenue
Paramus, NJ 07652
(201) 843-6400

ALLGON ANTENN 306 NW 25th St. Grand Prairie, Texas 75050 FAX: (214) 641-1945
1-800-445-7303 Wait for tone - dial 3887

Circle (27) on Fast Fact Card

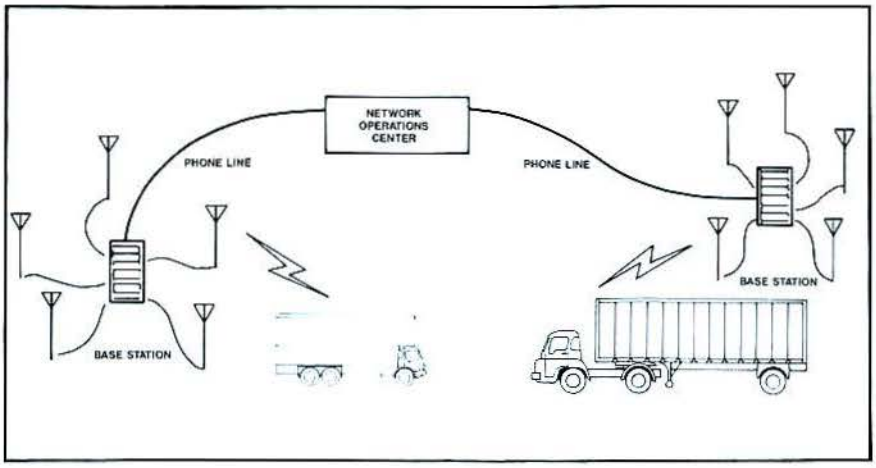


Figure 4. Telephone lines carry communications from dispatchers to the network operations center and from there to the base stations.

quency; mobile units respond on another:

- when they have a message for the base station.
- to acknowledge receipt of a message from the base station.
- when the base station polls them for position information.

Base stations transmit a continuous, 2kW probe signal on 43.92MHz. The probe signal reaches a mobile unit when a meteor creates a suitable trail of ions. Because billions of trails allow radio signals to "illuminate" tiny geographic spots, connections are made with each vehicle many times per hour.

When it receives the probe signal, the mobile unit responds with a short, 300W burst signal consisting of position data and, if needed, a communication text message. Message reception is acknowledged both ways.

Telephone lines carry communications from dispatchers to the network operations center and from there to the base stations. (See Figure 4 at the left.)

The extraordinarily high base station power is expected to overcome mobile unit reception problems in electrically noisy areas. Trucks often travel city street and highway routes shared by powerlines that can be noisy, and they often enter industrial areas characterized by high levels of radio noise. Much of the early system development concentrated on devising the proper balance between base station and mobile units, and with designing antenna configura-

NEW TUFFER THAN EVER!

Centurion just keeps puttin' you ahead in the game. Every time there is a new development, Centurion has it on the field before anybody else even has it in the play book. And they do it better.

Take these new molded antennas from Centurion. Tough. Sleek. Smooth. And down-right good lookin', too. (Kinda remind me of a certain duck I know!)

Centurion makes four styles of these EX Series molded portable radio antennas. They don't let a drop of moisture in, so they're great for use in adverse conditions. And they meet the spec's for most intrinsically safe and "ruggedized" radios.

Call today for details. Tell 'em Tuf Duck sent ya!

CENTURION INTERNATIONAL, INC.

800/228-4563

TUF DUCK

P.O. Box 82846 ● Lincoln, Nebraska 68501 ● U.S.A.
800-228-4563 ● in Nebraska (402) 467-4491
Fax:(402) 467-4528

Circle (29) on Fast Fact Card

tions for the base and mobile units.

Loran-C radiopositioning

Mobile units are equipped with a Loran-C receiver, a keyboard display, a radio transceiver and a single antenna. Loran stands for "*lo*ng *r*ange *n*avigation." Loran-C uses coastal transmitters in the 100kHz band to provide position information. Although Loran-C is designed for marine navigation, its signals are usable in most areas of the United States. For example, Loran-C is used throughout the United States for aircraft navigation.

The Loran-C receiver feeds position information to the radio transceiver. The information automatically is transmitted to the base station whenever the mobile transceiver responds to the probe signal.

The network operations center coordinates and monitors system operation. Its computerized communications facility directs base stations to transmit messages to particular vehicles. Data messages received at the base stations from mobile units flow back to the network operations center. The center monitors system operation and indicates any need for adjustments or repairs.

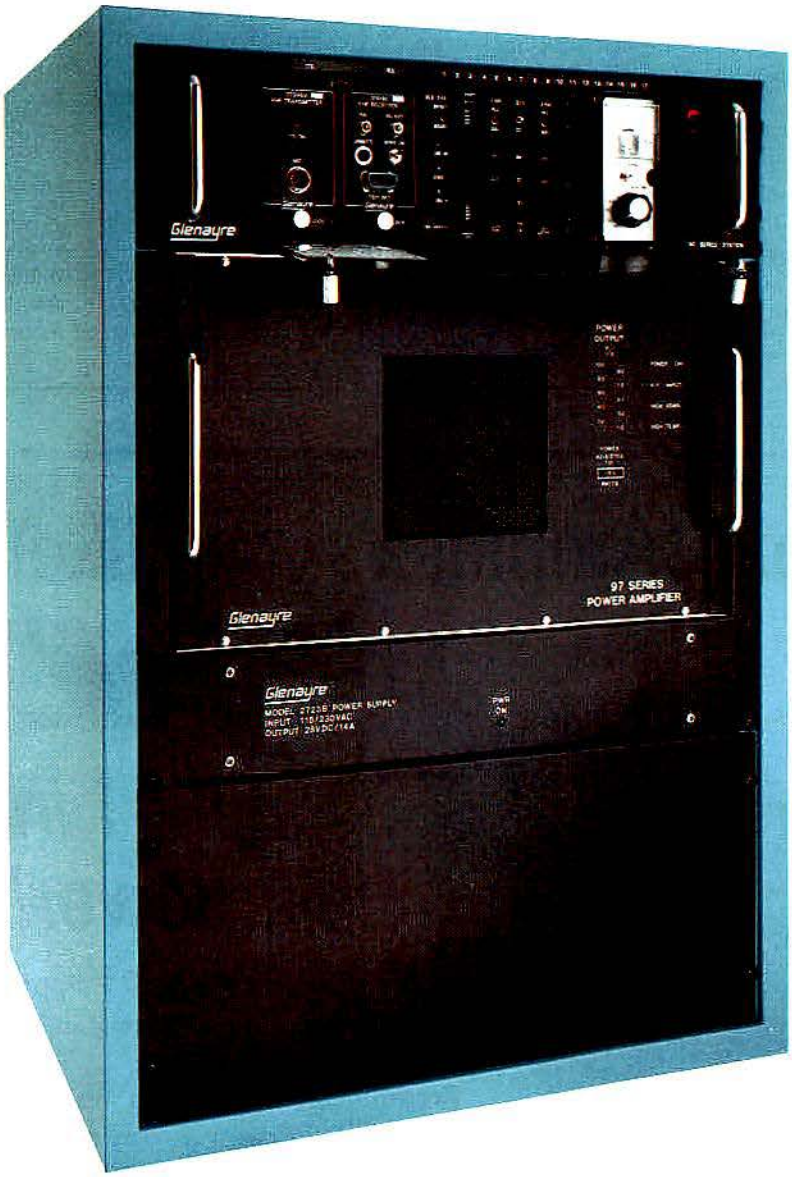
Trucking company support

Support from major trucking companies has been strong, according to a document provided to the FCC by Transtrack. Leaseway Transportation, a nationwide trucking company boasting a fleet of more than 50,000 vehicles, helped Transtrack set system specifications and requirements. Leaseway has helped to pay for research, development and testing. The document reads that Leaseway and other major trucking companies support Transtrack, indicating that its service will be accepted widely and used for fleets.

During 1986, a Transtrack subcontractor, Meteor Communications, Kent, WA, tested the feasibility of meteor scatter propagation for vehicle tracking and

Photo 4. Transtrack's base station equipment resembles this configuration of Meteor Communications Corporation equipment, but includes four receivers and a high-power transmitter.

RF TWO-WAY POWER



Ultra-Reliable Glenayre base stations and repeaters mean customer satisfaction and higher profits.

The same high quality engineering that goes into every Glenayre Paging and Radio Telephone Terminal and GL2021 control head enables you to provide your customers with a two-way service they can really count on.

Features:

- Flexible, plug-in modular construction allows the widest variety of configurations, including multiple station interconnect, radio link control and/or line control
- Adjustable RF/Squelch hysteresis on receiver
- 100% solid state reliability
- Space saving compact size
- FCC and DOC type accepted
- 19" rack mount format
- Continuous duty rated up to 250 Watts transmit power in UHF, VHF and up to 300 Watts in Low Band

Also available from Glenayre: Mountain top, low current repeaters.

- Designed for operation at remote sites where ac power is not available and where temperature or other environmental factors are extreme.

Best of all, your after sales service by the industry's leading application engineering team ensures outstanding technical support including a customer hot line and the finest tech-rep group in the business.

Glenayre, your best two-way power choice.

In Canada, call: (416) 470-2040
In U.S.A., call: 1-800-663-8807

Glenayre electronics ltd.

Look for our display at the Expo East show.

Circle (31) on Fast Fact Card

Vehicle tracking idea begins in Gulf of Mexico

Petroleum companies with drilling platforms in the Gulf of Mexico rely on information about ocean currents, especially during storms. Buoys equipped with instruments made by Horizon Marine, Marion, MA, measure electrical currents in the water and reveal speed and direction of currents. The buoys transmit their positions and the speed and direction information via Earth-orbiting satellites. Maps produced with the data provide the petroleum companies with detailed information about Gulf conditions.

Company president James Feeney said company engineers realized that trucking and other transportation companies could use position information to track fleet movements. Two-way data communications would be needed to utilize the capability fully. Horizon first used its satellite transmitters on trucks, but "it quickly became apparent that using satellites for this application would be too expensive," Feeney said, "so other technologies were considered."

Feeney formed Transtrack to pursue the idea. He obtained financial backing from Leaseway Transportation and a second potential customer, as well as several investors. Transtrack settled on meteor scatter communication as the most economical way to provide nationwide vehicle tracking and data communication.

mobile communications. (See Photo 5 on page 38.) The tests, conducted along the West Coast trucking corridor, led to the design Transtrack submitted for FCC approval.

Suitable communication performance extends to a radius of 800 miles from each base station. Weather conditions, urban terrain, rural terrain and vehicle speed have little, if any, effect on performance. The inner city "canyon" effect tall buildings have on terrestrial radio communications is not apparent with the signals reflected from ion trails.

Interference to the communications occurs instead from "micro-environmental" problems, such as vehicles parked under noisy powerline transformers and neon signs, and alongside or inside metal buildings.

Transtrack conducted a six-month pilot program with a trucking company fleet of 17,000 vehicles nationwide. The program was successful, and the trucking company has signed a contract for

Complete Cellular Systems!

Now, soar to greater heights with new, expanded and reconfigured cellular systems...complete from Decibel.

You get many advantages when you purchase your complete 824-960 MHz cellular antenna system from Decibel:

1. A wider **selection** of equipment,
2. Smoother operations with **compatible** equipment,
3. **Minimized maintenance,**
4. **Ease of expansion** with Decibel innovations.

Base Station Antennas

Decibel offers dozens of antenna configurations, including those for platform and tower Omni-Omni, low and high density AMPS, Motorola Omni/Sector, Sector/Sector, RSA systems and others.

Aeroglas™ omni antennas provide 3 to 10 dB gain and 3°, 6° or 10° electrical downtilt (or uptilt for inverted mounting.)

Sector antennas offer up to 17 dB gain for MSA and RSA (rural systems) and 1° to 15° mechanical downtilt.

Some Decibel directionals — omnis on aluminum screens — also offer electrical downtilt. And for special problems, many Yagi and other antennas are available.

High Quality Filters, Duplexers, Tx Combiners, Rx Multicouplers and Tower Top Preamps

Decibel's antenna systems equipment has the quality to meet your cellular needs, even with the demands of customer growth, site congestion and new frequency allocations.

This high quality is achieved by:

1. High Q, all-copper cavities, completely soldered,
2. Less costly aluminum cavities for less stringent requirements,
3. Stable Invar steel tuning pistons,
4. Silver plated current-carrying elements,
5. Beryllium copper fingerstock.

HELIAX is a registered trademark of Andrew Corp.

All Cables, Connectors and Hardware

Decibel offers all the necessary hardware and connectors — fitted or unfitted — along with the finest low-loss HELIAX® coaxial cables. These include ½" to 1⅝" foam and ⅞" to 2¼" air dielectric as well as Superflexible.

High Quality Mobile Antennas, too!

Thousands of field tests have been made by Decibel at our own test range in Dallas. Results show that in general (1) quality antennas last longer, and (2) Decibel's mobile antennas outperform the competitors'!

Super System Support

Power amplifiers — 12 to 350 watts — are available from Decibel, also static to dynamic modifications for Harris, Avantek and Kokusai amplifiers.

Sentry™ Remote Site Monitors that can handle from one to 64 Tx/Antennas are offered to give you (1) more up-time, (2) less routine maintenance, and (3) lower repair costs.

Decibel Systems Engineers can help you with advice, designs and quotations.

For More About Decibel's Complete Cellular Systems

Contact Marketing, Decibel Products, Inc., P.O. Box 569610, Dallas TX 75356-9610. Telephone (214) 631-0310. Telex 73-0212. FAX (214) 631-4706.

Decibel is a Business Unit of Alliance Telecommunications Corporation.

Visit us at CTIA Booth #300.

If you want quality, you want Decibel! Leadership since 1947.

DB8900 Tower Top Preamplifiers use System A or B custom preselector filters such as the DB4257Z14-C (pictured below).

DB8500 Rx Multicouplers, with System A or B preselector filter, expand to 32 channels.

Decibel offers 12- to 350-watt MSA or RSA Power Amplifiers, also modifications.

New DB1965 Cel-Tel™ Portable Tester for cellular phones.

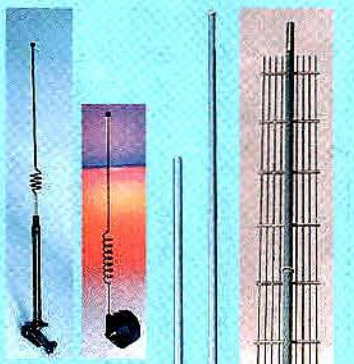
DB4200 aperture-coupled Tx Bandpass Filters handle regular and new System A and B.

DB4187 uses Tx (to 600 watts) and Rx filters for 825-890 MHz duplexing.

New, improved, expandable DB8060 combines 2 to 20 150-watt transmitters as close as 250 KHz.

Decibel carries HELIAX® foam and air dielectric cables, also Superflexible.

DB8860 Sentry™ Remote Site Monitor reports and controls up to 64 Tx/Antennas.



DB737B trunk-edge mount and DBglas™ DB749B glass mount mobile antennas provide 3 dB gain.

(Left) DB803XI, 806XI and 809XI with 3, 6 or 9 dB gain are FWD™ omnis with Minimum-Tip-Deflection™.

(Center) DB559 9 dBd gain Aeroglas™ omnis offer optional 3°, 6° or 10° electrical downtilt.

(Right) DB561/4 Sector Antennas provide 11 to 14 dB gain and 120° to 170° patterns, optional mechanical downtilt.

With pipe mount.

DB833-A,-B or -F 9 dBd gain 105° antennas mount to AMPS platforms or with pipe mount kits; DB833F for EIA flange, DB833P for pressurized with flange.

Factory Authorized Warehouses: Tekcom, Inc., Costa Mesa and Union City CA; **Talley Electronics Co.,** Hayward CA, Santa Fe Springs CA and Phoenix AZ; **CW Electronics,** Denver CO; **The Antenna Farm,** Overland Park KS; **M. Hutton Co.,** Dallas TX; **ComMar, Inc.,** Westport MA; **Tessco, Inc.,** Hunt Valley MD, Tampa FL, Schaumburg IL, and Sparks NV; **Primus Electronics Corp.,** Joliet IL.
International: Marketronics, Sunrise FL (for South America), **Lenbrook Industries, Ltd.,** (Canada) St. Leonards, Quebec; Calgary, Alberta, and Pickering, Ontario, **RAC,** (Italy) Milan; **Walmore Electronics, Ltd.,** (England) London; **OmniTronics Enterprises PTE Ltd.,** (Singapore), **Sistemas Profesionales S.A.,** (Mexico), Mexico City; **R.F. Devices Pty.,** (NSW Australia) Miller.

Circle (33) on Fast Fact Card

Photo 5. In 1986, a Transtrack subcontractor, Meteor Communications Corporation, tested the feasibility of meteor-scatter propagation for vehicle tracking and mobile communications.

production of vehicle units and services to begin equipping the fleet. Transtrack officials declined to name the trucking company.

Vehicle tracking and mobile data communication offer trucking companies fleet management advantages:

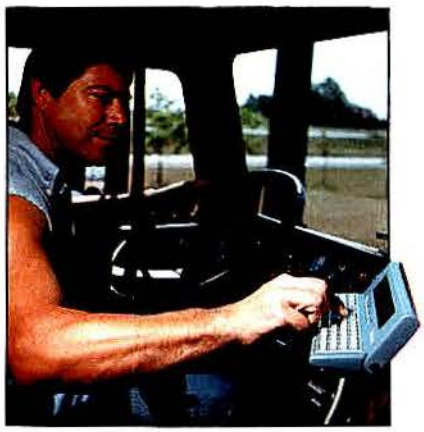
- Rerouting decisions are made easily when dispatchers know the locations of units.
- Information about diversions to new pickup points can be relayed.
- Carrier efficiency is improved by reducing distances traveled with empty loads.
- Hourly updates can be made on "just-in-time" deliveries.
- Check-in calls are reduced.
- Dispatchers can monitor the number of hours the drivers work.
- With text message capabilities, drivers and dispatchers can transmit information such as arrival times and bills of lading.

Improved efficiency in transporting goods boosts U.S. manufacturers' competitiveness. The system's ability to log driver hours and calculate average speed figures will help to improve driver safety, as well.

Reduced capital costs for meteor-scatter communication compared to satellite transmission translates into the potential for efficient, widespread use of vehicle tracking and data communication.

Other meteor systems

The first, large-scale system to use meteor-scatter communications, Snotel, was created by the Department of Agriculture in the 1970s. The system uses 1,000W remote base stations on 40.53MHz and remote data terminal stations on 41.53MHz to keep track of "water management resources." Two remote base stations and 700 remote data terminals cover 11 western states.



A truck driver uses a Pegasus keyboard to prepare a data message for transmission.

Enron, a natural gas pipeline company, operates another large system. The 4-year-old system uses a 500W base station in Mynard, NE, on 48.68MHz to acquire data from pipeline units. The base station communicates with remote units in Minnesota, Michigan and Wisconsin.

Pegasus

Pegasus Message Corporation of Herndon, VA, also offers meteor-scatter communication service. During 1988 tests, the company's Load-Trak tracking and two-way communications system covered eastern and central U.S. regions. More than 100 mobile systems have been tested. Nationwide coverage is expected to be offered in 1989.

Pegasus has an experimental license for its tests and commercial operation. The license covers a base station in Kentucky and various mobile units. The two-year license expires July 1, 1989. Experimental licenses may be canceled by the FCC at any time, although they are renewable as well.

The Kentucky base station's equipment can handle 10kW RF output at 49.595MHz. Vehicle transmitters use 47.005MHz. The frequencies are part of a government allocation. Under a regular license, which Pegasus plans to apply for this year, it seems likely that alternative frequencies would have to be used.

Pegasus has developed proprietary equipment and network software with U.S. and offshore suppliers. Stand-alone PC-based terminals at customer facilities perform messaging and position-locating functions.

The system designers used their prior experience in networking mainframe computers to offer their customers an advantage: Dispatchers may access the Pegasus network database via existing terminals and may use their own host computers.

Uniden supplies the mobile transceivers and the base station exciter. Henry Radio supplies the base station power amplifier.

IN-STOCK
FOR IMMEDIATE SHIPPING

Affordable Wireless Data Recorder

At only $595.00 printed communication between base station computers and mobile units is now affordable for everyone. The AR1200 stores and prints messages or receives and prints simultaneously. Easy to operate; compact size; full 40 characters per line printer output.

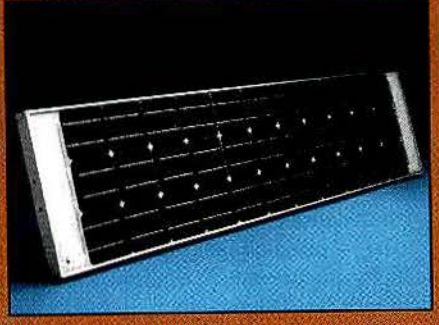
Also available, other computer and data transmitting products.

Tempo™ Mobile Radios

Economical, reliable mobile transceivers are available for immediate shipment. Several models offer a choice of features to the two-way customer. Type accepted for all business and public safety uses.

RF Power Amplifiers

We've got RF Amplifiers in-stock. Delivery when you need it. Guaranteed to specs, year after year. We've got our dependable reputation behind these products and offer them at realistic prices. You can count on Henry Radio!



Hoxan™ Photovoltaic Products

The reliability of Hoxan solar products is backed by a 10 year guarantee. True quality that lets you enjoy complete independence from utility lines or fuel storage tanks. Completely modular units can add or subtract from a system easily. Reliability, independence, modularity, economy, safety. Henry Radio is your best choice for communications power.

Over a half-century of reliability in communications.

HENRY RADIO

Also in stock: ASTRON Power Supplies, CUSHCRAFT Antennas, LARSEN Antennas, MAXCOM Antenna Tuners, PIPO Touchtone Pads, MAG INSTRUMENTS Flashlights plus much more two-way and amateur radio equipment and supplies.

2050 S. Bundy Drive, Los Angeles, CA 90025; toll free: 1-800-877-7979; FAX: 1-213-826-7790

Circle (34) on Fast Fact Card

Lightning sparks debate: *Prevention* or *protection*?

Lightning-preventing ion dissipators always work, almost always work or do not work, according to various manufacturers, users and critics. Disputes involve operating theory, configuration and installation.

By Don Bishop
Editorial Director

How to safeguard radio communications facilities from damage caused by lightning has been a popular topic ever since our first article on the subject appeared in August 1983.[18] (References appear at the end of the article.)

Lightning prevention advocates recommend the use of multipointed metal terminals—*ion dissipators*—to alter the static electrical charge on or near an antenna, tower or building, or at the thundercloud. The object is to reduce the likelihood of, or to prevent entirely, a lightning strike.[14, 15, 22, 25, 28, 33]

Critics state that upgrading a communications facility's surge protection and grounding during the course of lightning prevention equipment installation is what stops lightning strikes from causing damage—not the ion dissipators. Ion dissipators, according to critics, are superfluous. Lightning continues to strike, they say, but users are unaware of it because damage is reduced or prevented by factors other than the dissipators.

Many ion dissipator users are enthusiastic, though. One manufacturer sent copies of 11 testimonial letters that say no lightning struck, or at least caused no damage, after lightning prevention equipment was installed. We talked with two of the users:

Chicago

An ion dissipator, a Verda unit from Lightning Deterrent Corporation, is installed above the WLS-TV antenna atop the Sears Tower in Chicago.

"Whether it stops hits or not, I do not know," said Jerry Powell, an engineering manager for the RF section at WLS-TV. "The transmitter has not tripped off because of VSWR, but that is the only indicator we have."

Powell said lightning obviously continues to strike the rooftop below the antenna "because we do get equipment moving around the room. The current travels through the building skin, and the surge actually moves the equipment.

"Lightning rods on the rooftop continue to be struck," Powell said. "We do not know whether lightning continues to strike the tower." Powell attributes the lack of damage to the use of lightning protection equipment such as metal-oxide varistors.

Asheville, NC

Dale P. Kelley, director of engineering for Pappas Telecasting Companies, Visalia, CA, uses two manufacturers' lightning prevention units.

"Since installing the units, we have had no damage from lightning," he said. "How much that can be attributed to the dissipators I cannot say."

Kelley said he pays careful attention to the grounding systems on his company's towers. "The whole idea is to be sure that lightning current is conducted to ground if lightning hits the tower."

Prevention vs. *protection*

Lightning *prevention* implies reducing or eliminating lightning strikes to an antenna, tower or building.

- ☐ **All lightning prevention equipment makers use one or more multipointed metal terminals elevated into the air to dissipate ions.**
- ☐ **Some include radial ground wires connected to the terminals with a conductor.**
- ☐ **One includes a curtain of barbed wire as a part of some installations.**

Lightning *protection* implies safeguarding electronic components from the damaging effects of electrical current surges caused by direct or nearby lightning strikes. The method includes:

- ☐ **conducting as much of the surge current as possible harmlessly to ground.**
- ☐ **isolating the electronics from surge sources.**
- ☐ **grounding and bonding the electronics in such a way that the electrical potential on all components rises and falls equally as surge current passes, averting harmful current flow *between* components.**

The DXT is licensed by GENERAL ELECTRIC to interface with the GE-16 PLUS public safety trunking system.

DXT

MOBILE DIGITAL TERMINAL

Increase productivity of field personnel through fast, accurate and secure transmission of information. Kustom's DXTs are a vital enhancement to any existing or planned two-way radio operation.

User benefits include:

- Greater message capacity.
- Reduced message confusion inherent with voice communications.
- Data transmission in a matter of seconds, increasing air time service revenue.
- Interfaces with any radio.
- Operates on VHF or UHF and 800 MHZ conventional or trunked radio systems.

Other Mobile Digital Terminals available from Kustom — The MCT-30 & KST.

MCT-30

KST

From The Leader in state-of-the-art digital communications!

KUSTOM ELECTRONICS INC.

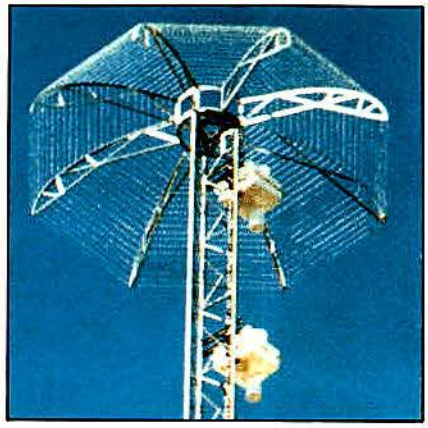
8320 Nieman Road, Lenexa, KS 66214
Telephone (913) 492-1400

Circle (35) on Fast Fact Card

He also uses a coaxial suppression system for the ac power mains to prevent surge current from reaching the transmitters.

Kelley said he has seen many storms near one of the company's towers, a 1,600-foot structure near Asheville, NC. "I have never seen the tower struck by lightning. I do have reports from residents in the area who say they have seen lightning strike the tower when a LEC [Lightning Eliminators and Consultants] system was in use and later when it had been replaced with a Verda unit."

Kelley said he replaced elements of the LEC system, an umbrella-shaped dissipator and curtains of barbed dissipator wire, because it was damaged by ice. He found the Verda unit to be



Concentric rings of barbed wire form Lightning Eliminators and Consultants' umbrella-shaped ion dissipator.

"sturdier." Kelley said he has been told that the LEC system since has been improved to withstand iceloading without damage. But he said he did not want to subject the tower to the additional weight and potential windload that the larger LEC system, when coated with heavy ice, would have subjected it to.

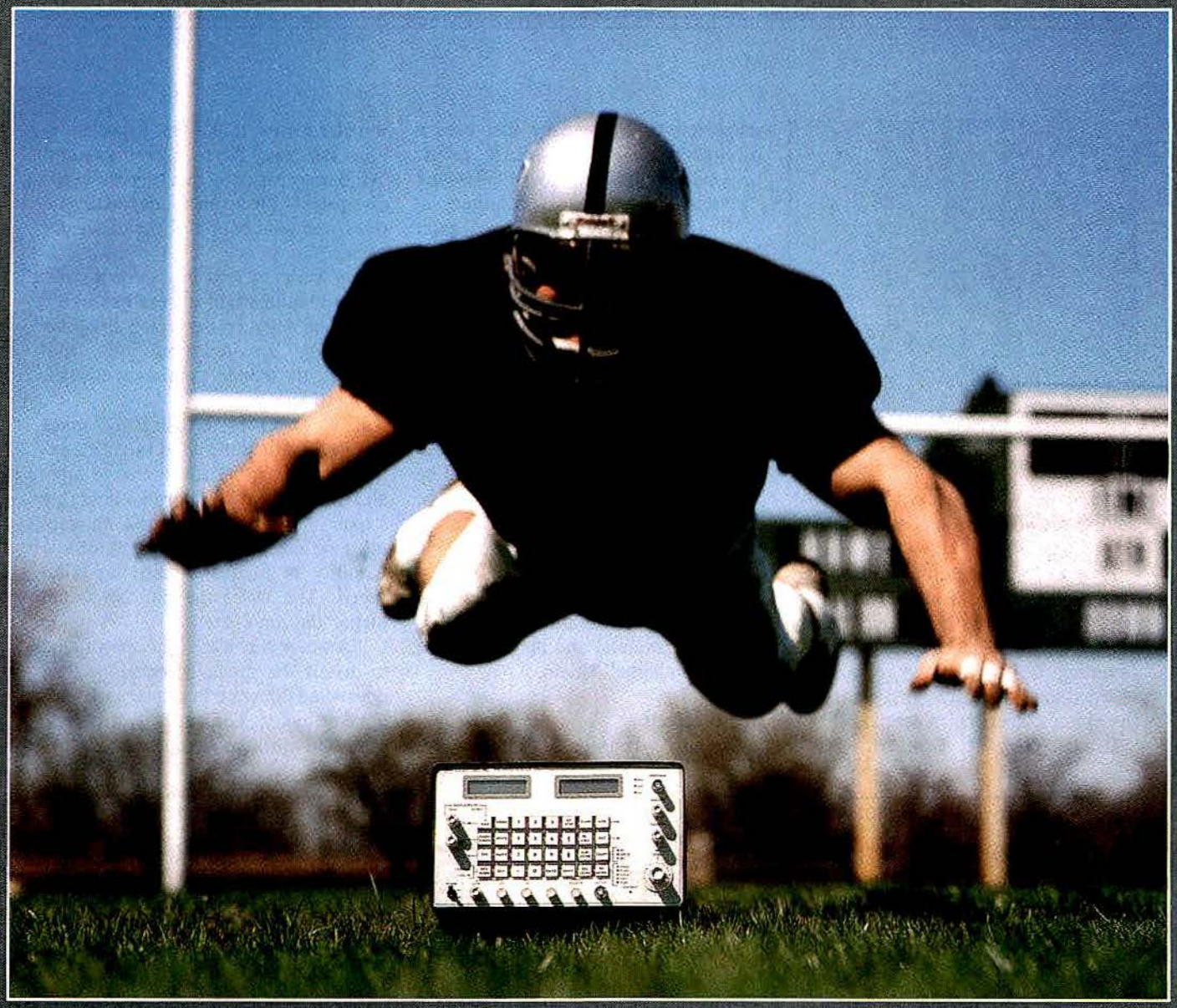
"The different units are equally effective or ineffective, as the case may be," Kelley said.

He continues to use LEC units on his company's Fresno, CA, tower, but he installed a Verda unit when his company built a 1,500-foot tower near Omaha, NE, three years ago. He expressed satisfaction with both.

Pro and con

Lately, the magazine's authors and readers have been cast into two groups:

- The first group supports the use of multipointed metal terminals elevated into the air to reduce or prevent lightning strikes. (Manufacturers' effectiveness claims differ.) For simplicity, we refer to this method as "lightning *prevention*." Authors whose works tend to fall into this category include Carpenter, Drabkin, Fawthrop, Gillem, Hudalla, Kaiser, Nott, Sulyma and Vir James P.C.
- The second group supports the use of grounding techniques and other protective devices to conduct lightning current harmlessly into the earth and to prevent damaging current from flowing through electronic equipment. We refer to this method as "lightning *protection*." Authors whose works tend to fall into this category include Block, Claussen, Keniston, Sullivan and Little. (A list of



Tough Enough To Join Our All Star Team!

The CT Systems Model 2100 Service Monitor is another in our front line of low cost heavy hitters.

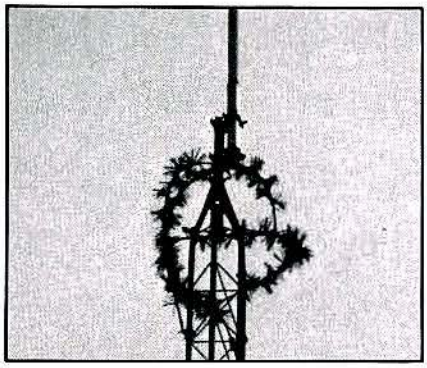
With an introductory price of only $2495, the Model 2100 is built to play in the same league as instruments costing thousands of dollars more. Its rugged and reliable capabilities make it error free in the field or on the bench.

The Model 2100 is well equipped with standard features that allow it to tackle any job. Features like High Resolution Dual Digital Displays, FM Deviation Markers, Memory Storage and Recall, Built-In Frequency Counter and Off-The-Air Monitoring.

Regardless of where you need it, on the road or at home, the CT Systems Model 2100 Service Monitor is a winner. Give us a call at 800-245-6356 and we'll let you know the score.

Circle (38) on Fast Fact Card

CT SYSTEMS, INC.
5245 HORNET AVE.
P.O. BOX 470
BEECH GROVE, IN 46107-0470
800-245-6356
317-787-5721



Lightning Master's 'static dissipator' takes different shapes on different towers.

manufacturers with whom some of the authors are affiliated appears at the end of the article.)

Here is an example of one disputed statement, taken from our April 1988 article: "The ion mass the [dissipation] array produces is expected to act as a lightning shield as the oppositely charged ions recombine and neutralize the cloud's electrical potential."[14]

Reader Gary A. Minker, who is employed by a company that uses a dissipator on its broadcast tower, responded in the November 1988 issue's "Letters To The Editor" column:

"To avoid these [lightning] strikes, it is not necessary to 'neutralize the cloud.' Instead, the dissipative systems should make the potential targets of these strikes 'invisible.' The physical explanation that supports the various forms of dissipative equipment being manufactured was accepted long ago."

But whose physical explanation has been accepted, and who accepted it? For example, the 1979 U.S. patent held by LEC owner Roy B. Carpenter Jr. reads, "The cloud potential is reduced by those ions reaching them, thus neutralizing some portion of its overall charge."[15] The patent lists two more mechanisms: the reduction of the protected object's electrical potential and the creation of a "space charge" shield.

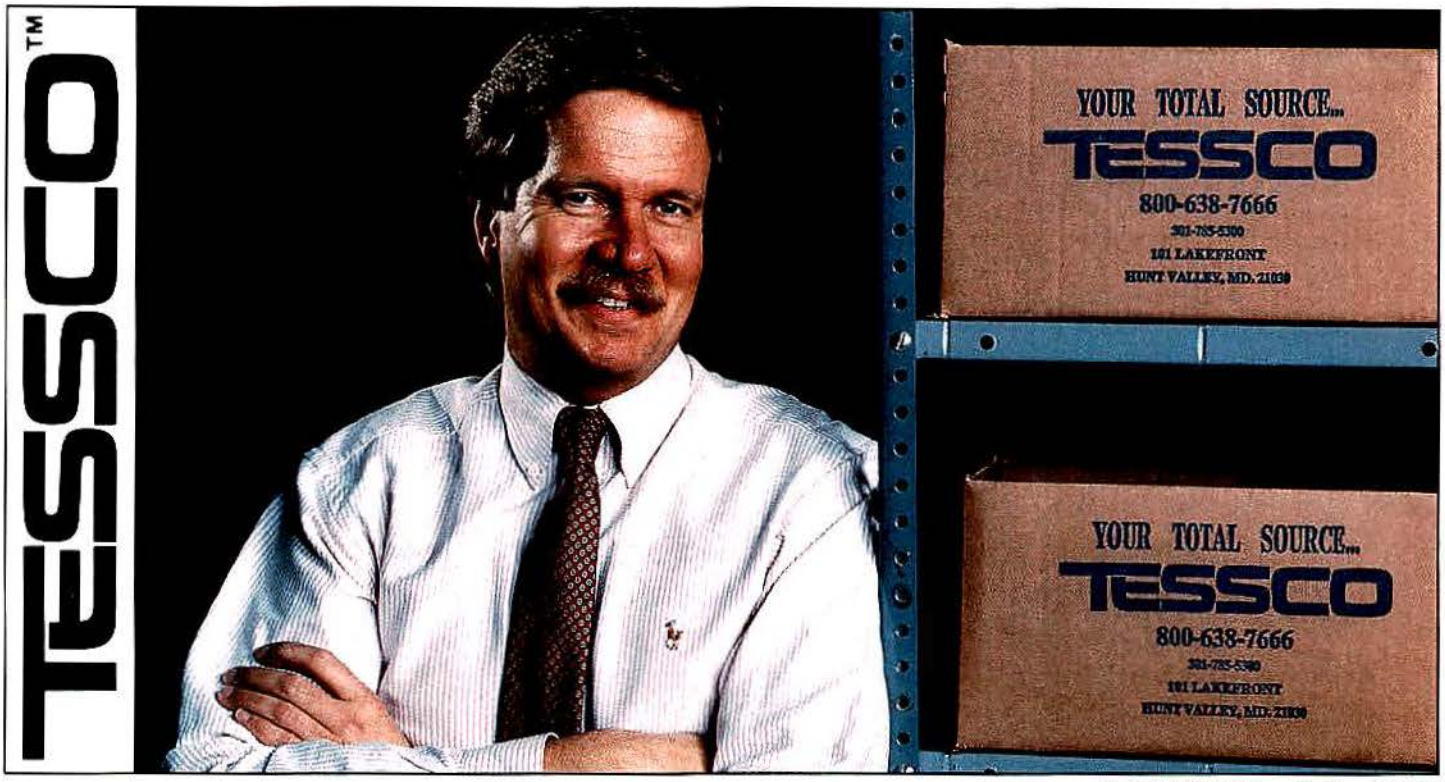
Wind effects

Strong winds associated with thunderstorms might be expected to blow ions away from an ion dissipator. Wind may or may not decrease the dissipator's effectiveness, depending on one's opinion about how the dissipator works.

If it works by reducing some portion of the thundercloud's overall charge,[15] then wind might render an ion dissipator ineffective by preventing ions from reaching the thundercloud soon enough, or at all.

If it works by creating a "space charge,"[15,20] then the wind might be expected to blow the space charge away and expose the dissipator to a lightning strike. "The potential wind velocity must be taken into account since ion mobility is related directly to wind speed. The faster the ion flows, the higher the ion current.

"However, the faster wind speeds tend to distort the protected envelope in a downwind direction in consonance with wind velocity. The result can be unprotected areas on the upwind side. As



Robert B. Barnhill, Jr. — President TESSCO

"At TESSCO, the Buck Stops with Me...and I Care"

To me, customer service isn't just some industry catch phrase. It's a real concern, and something I believe TESSCO does better than anyone else out there. You see, I understand that your success is our success. So doing what it takes to help make your business more profitable is what my business is all about — doing it as well as we do is good news for both of us.

We Give You A "Total Source" Product Line...

You don't want to waste time shopping a lot of different suppliers for the items you need. So we give you a "Total Source" product line of over 10,000 items from more than 60 of the industry's best-known manufacturers. From antennas to cable, tools to test equipment, it's all right here.

A Competitive Bottom Line...

Of course, our huge selection wouldn't mean much if you still had to shop other suppliers for price. So we do everything we can to make sure you get the items you need at the lowest bottom-line cost. If you can do better anywhere else, let us know... we'll try to make up the difference.

Delivery and Quality You Can Bank On...

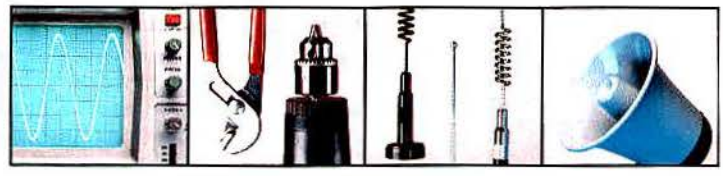
Our toll-free 800 number makes it easy to place your order. And our nationwide network of distribution centers is the best way we know of to deliver your order when you need it, at the lowest possible cost to you. Best of all, your order is completely risk free. Take up to fifteen days to look it over. If you decide it's not what you need, send it back for a credit or prompt refund.

And We'll Treat Your Order With Care

When you buy from TESSCO, you're buying from one of the nation's largest suppliers of communications support products. But we didn't get here by serving only our largest customers. We did it by going the extra mile to keep *all* of our customers happy, regardless of size. So whether you need a handful of battery taps or a complete antenna system, you can bet we'll treat your order like it's the most important thing in the world... because to you and your business, it is.

So go ahead, send in the attached information card or give us a call on our toll-free number. Either way, you'll be treating yourself and your business to the best service in the industry. How can I be so sure? Because at TESSCO, the buck stops with me... and I care.

Robert B. Barnhill, Jr.
President TESSCO



TESSCO™
Your Total Source®
800-638-7666

Chicago, Illinois | Baltimore, Maryland | Reno, Nevada | Tampa, Florida

GW5

Circle (40) on Fast Fact Card

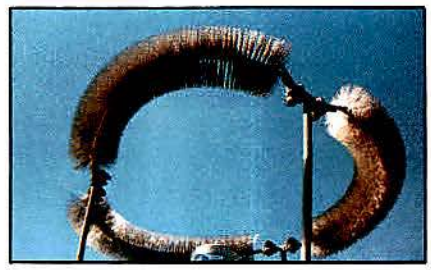
a result, prevailing wind conditions must be considered in the design and the array must be located, oriented or configured to compensate for wind effects."[15]

If it works by neutralizing the charge of the object on which it is mounted, then it may be rendered ineffective by a thundercloud charge strong enough to generate a lightning strike to either a neutral or an oppositely charged object.

Configurations

Ion dissipator manufacturers have specifications for optimum dissipator performance.

One specifies: "The maximum number of wires is 250 per inch. The wires are preferably 10 inches long and have a diameter of about 0.014-inch. The preferred material...is an antimagnetic grade of stainless steel such as No. 303."[22]



Lightning Deterrent Corporation's ion dissipator 'does not need to tie into the ground wire system to function.' [36]

Another offers formulas to show that a 0.005-inch-thick wire is nine times as efficient as a 0.015-inch-thick wire.[26]

Another recommends much thicker wires, such as 1/8-inch-thick, tapered spikes, because: "Dissipators composed of thin wires for points may be deformed by hail, ice, wind and other powerful weather effects."[33]

Some say the points should be close together; others say they should be far apart. Some say the dissipator may be compact; some say it should occupy a relatively large volume, shaped to "form lines of equal potential around the ionizer structure."[15]

How effective is prevention?

Which is better, lightning prevention or lightning protection? More important, which is *effective*?

A lightning strike's damaging electrical current may enter electronic equipment several ways. A tower strike is only one way. Nearby strikes may cause surge current to flow on telephone, control and ac power lines that connect with electronic equipment. Induced current may flow on coaxial cables.

Do lightning prevention devices prevent lightning strikes? Manufacturers are divided:

- *Cortana Corporation*: "A point discharge dissipation system can, if properly designed, fabricated and installed, greatly reduce lightning strikes and static electricity on any tall structure."[33]
- *Lightning Deterrent Corporation*: "The Verda lightning deterrent unit *prevents* the lightning stroke by leaking away the cloud-to-ground potential as

The information in this brochure could revolutionize your radio system capability—and budget—for the next 10 years. Call 1-800-MIDLAND, Ext. 1690.
(In Missouri: 816/241-8500)

Syn-Tech II.™ The radio designed to put you in control.

Before designing our new advanced-technology Syn-Tech II™ radios we asked system operators what they wanted in their "ideal" mobile. No surprise: everyone wanted a different set of features. But they *all* wanted more functional control and flexibility...and a radio as easy to use as possible within their system parameters.

Midland's solution: our new chameleon-like, software-driven Syn-Tech II, a single high-performance mobile configurable in literally millions of ways to a user's precise requirements, simple or complex. Syn-Tech II puts *you* in charge, lets *you* decide exactly which functions you want programmed and displayed.

Control units are interchangeable and control panel switch/indicator functions are programmable. You can decide which switches and indicators you need, what they should do, even how they are labeled. You determine which functions will be operator-selectable or operator-alterable—and this can be different for different groups of operators. In short, the user-friendly Syn-Tech II gives you the control over your system you've always wanted.

Syn-Tech II is incredibly capable, too. Ultra-high performance specifications. Wideband. 320 channels, programmable in 16 groups. Data capable. Full-duplex option. Built-in CTCSS, digital squelch, DTMF/ANI, channel scan and dual priority. Plus many, many other features and options.

Syn-Tech II has an external programming jack, needs no tuning and is "clonable." Die-cast chassis. Meets or exceeds MIL 810C/D for shock and vibration; kit-capable for resistance to salt-fog, rain and dust. Simple dash/trunk-mount convertability. 15% smaller than our original Syn-Tech mobiles, too.

Price? A whole lot less than anything *remotely* comparable!

MIDLAND LMR
LAND MOBILE RADIO
1690 N. Topping, Kansas City, MO 64120

Circle (43) on Fast Fact Card

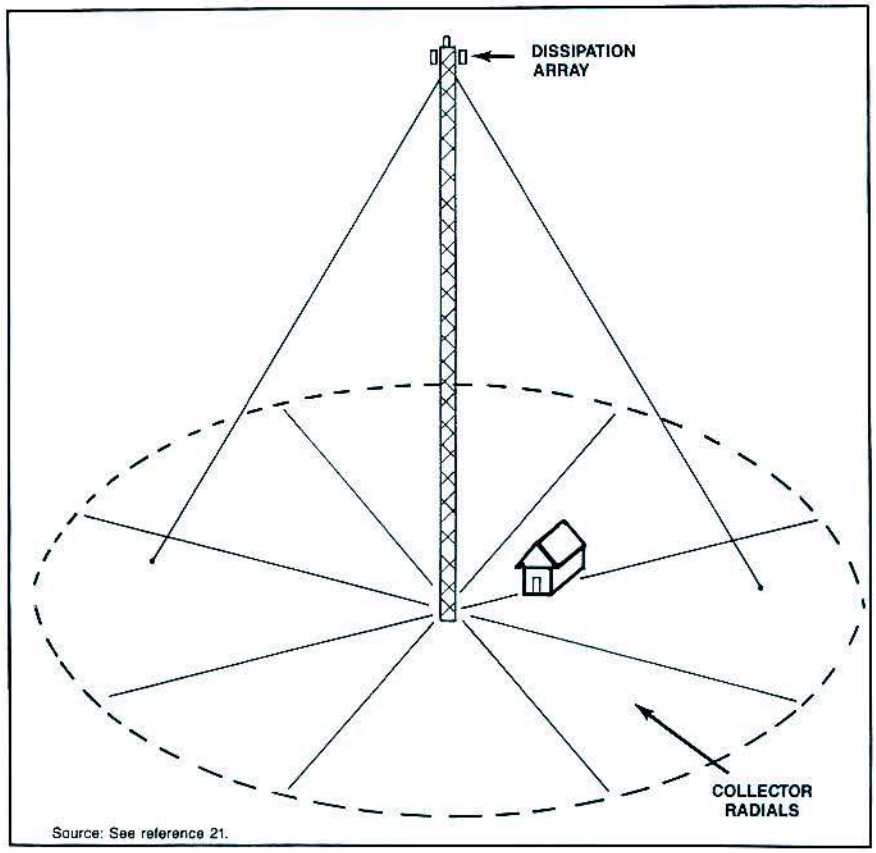


Figure 1. Lightning Prevention Systems specifies a set of copper radial wires extending from the base of the tower as part of its ion dissipation system.

the result of the aggregate of thousands of point discharges."[24] "...we use the word 'deterrent' because we don't believe a product can *eliminate* strikes. Also, we know there is no such thing as *prevention* because the lightning is there—it's always there—and since it exists, we can only hope to deter it."[36]

- *Lightning Eliminators and Consultants*: "During the past 17 years, LEC has been developing and accumulating statistics on a lightning strike prevention system called the Dissipation Array system. It has accumulated over 4,000 systems-years of statistics, proving that lightning strikes can be eliminated."[17]
- *Lightning Master*: "Claims of absolute reliability to prevent lightning strikes, claims which have historically been unfounded in reality, do nothing to encourage the legitimacy and industry perception of this application of point discharge technology."[25] "The static dissipation array must be a good conductor to provide maximum discharge of current during normal operation and, in the unlikely event of a direct lightning strike to the dissipator, a path for current flow in its role as a lightning rod."[26]
- *Lightning Prevention Systems (LPS)*: "Dissipation arrays are gaining popularity as an effective means of preventing lightning strikes to communications towers."[21]
- *Vir James P.C.*: "The product prevents lightning strikes." (From an Oct. 6, 1988, telephone conversation with Timothy C. Cutforth, president and director of engineering.)

Ground screen

Some manufacturers specify a "collector" composed of wire radials extended from the tower base and terminated by ground rods.

"The collector system is used to gather surface charges and deliver them to the dissipation array. It consists of a number of copper radials extending from the base of the tower."[21] (See Figure 1 above.)

"The ground current collector provides the source of charge to keep the ion current flowing through the

THE QUINTRON PHILOSOPHY

Reliability can't be compromised

We know not every Quintron two-way simulcast system serves emergency services. Yet we build them all to that consistently high standard, *never* compromising reliability with cheap components, manufacturing and testing shortcuts or shoddy workmanship. We understand your need for crisp, clear communications, no matter whom you serve.

At Quintron, we are committed to the highest standards of excellence in design, manufacturing, testing and after-sale support services. For example, higher system reliability was one goal of our pioneering work in simulcasting. Today this technology provides Quintron owners with better building penetration, expanded coverage, improved signal quality, lower operational costs and greater profitability.

You can rely on Quintron for value . . . without compromise.

QUINTRON and you . . .
The partnership for success

Quintron CORPORATION

One Quintron Way P.O. Box 3726
Quincy, Illinois 62305 Phone 217-223-3225

In Canada: LeBlanc & Royle Telcom Inc.
514 Chartwell Road
Oakville, Ontario L6J 5C5
(416) 844-1242

QUINTRON

Circle (45) on Fast Fact Card

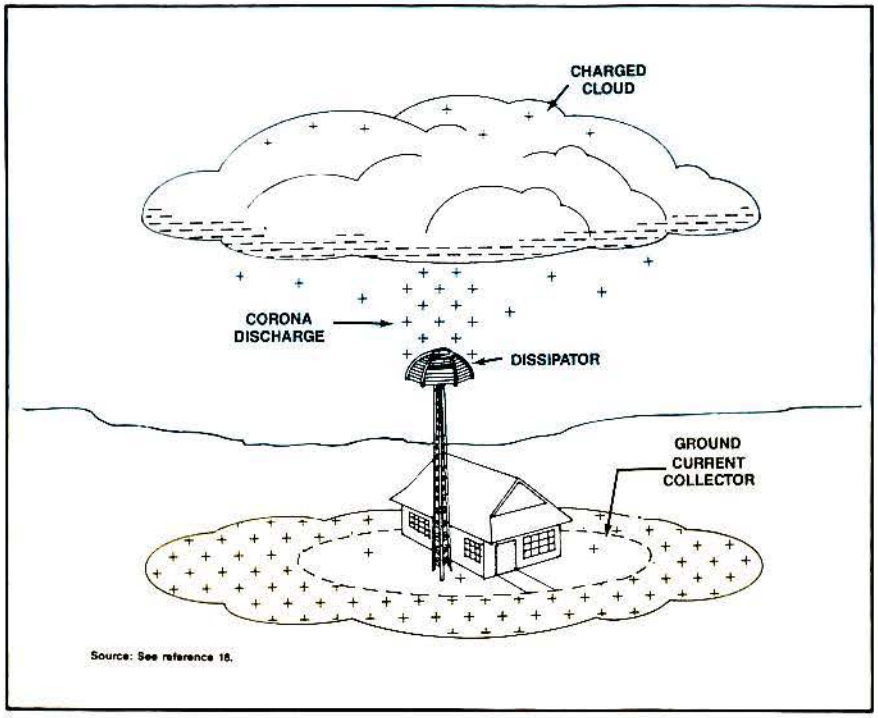


Figure 2. Lightning Eliminators and Consultants specifies a ground current collector made of buried radial wires terminated by ground rods.

array."[17] (See Figure 2 above.)

Another manufacturer finds any existing ground sufficient: "...take advantage of any existing grounding and bonding provisions, particularly if the structure is a building."[26]

One manufacturer disavows the need for a ground connection: "The unit does not need to tie into the ground wire system to function."[36]

Use 'protection,' too

Lightning prevention devices do not safeguard electronics from damage caused by surge current; lightning protection devices do. For that reason, some lightning prevention device manufacturers recommend the installation of lightning protection devices and a grounding system as well as their own products.

LPS: "Good grounding techniques and transient surge suppressor devices should be complemented with ion dissipation arrays on the tower to provide a more comprehensive lightning protection system..."[15]

LEC: "The ideal lightning protection system is one that consists of:

"(1) A Dissipation Array system to prevent direct strikes to the site.

"(2) A series hybrid surge eliminator to prevent the passage of unwanted power line voltage anomalies.

"(3) A series hybrid transient eliminator in each low-voltage data or control line that penetrates the strike-protected area to eliminate the induced transients.

"(4) An integrated circumferential ground system that ties all ground connections into a single, low-resistance, low-surge-impedance ground."[17]

Lightning Master: "...installation of a [static dissipation array] system is not a stand-alone solution. It always should be used in conjunction with other available remedies, including transient line surge equipment and effective grounding."[26]

Fans and critics

Lightning prevention has an abundance of supporters. Each manufacturer has testimonials. In talking with manufacturers, we find that most have examples of competitors' installations that failed for one reason or another.

Lightning prevention has its critics, too.

Making the decision whether to use ion dissipation devices to protect radio installations is made no easier by the diverse opinions on the subject.

Companies making lightning prevention equipment based on ion dissipation techniques are:

Cortana Corporation
Circle (200) on Fast Fact Card

Lightning Deterrent Corporation
Circle (201) on Fast Fact Card

Lightning Eliminators and Consultants
Circle (202) on Fast Fact Card

Lightning Master
Circle (203) on Fast Fact Card

Lightning Prevention Systems
Circle (204) on Fast Fact Card

Vir James P.C.
Circle (205) on Fast Fact Card

Companies making lightning protection equipment are:

Alpha Delta Communications
Circle (206) on Fast Fact Card

Cushcraft/Signals
Circle (207) on Fast Fact Card

Harger Lightning Protection
Circle (208) on Fast Fact Card

MCG Electronics
Circle (209) on Fast Fact Card

PolyPhaser
Circle (210) on Fast Fact Card

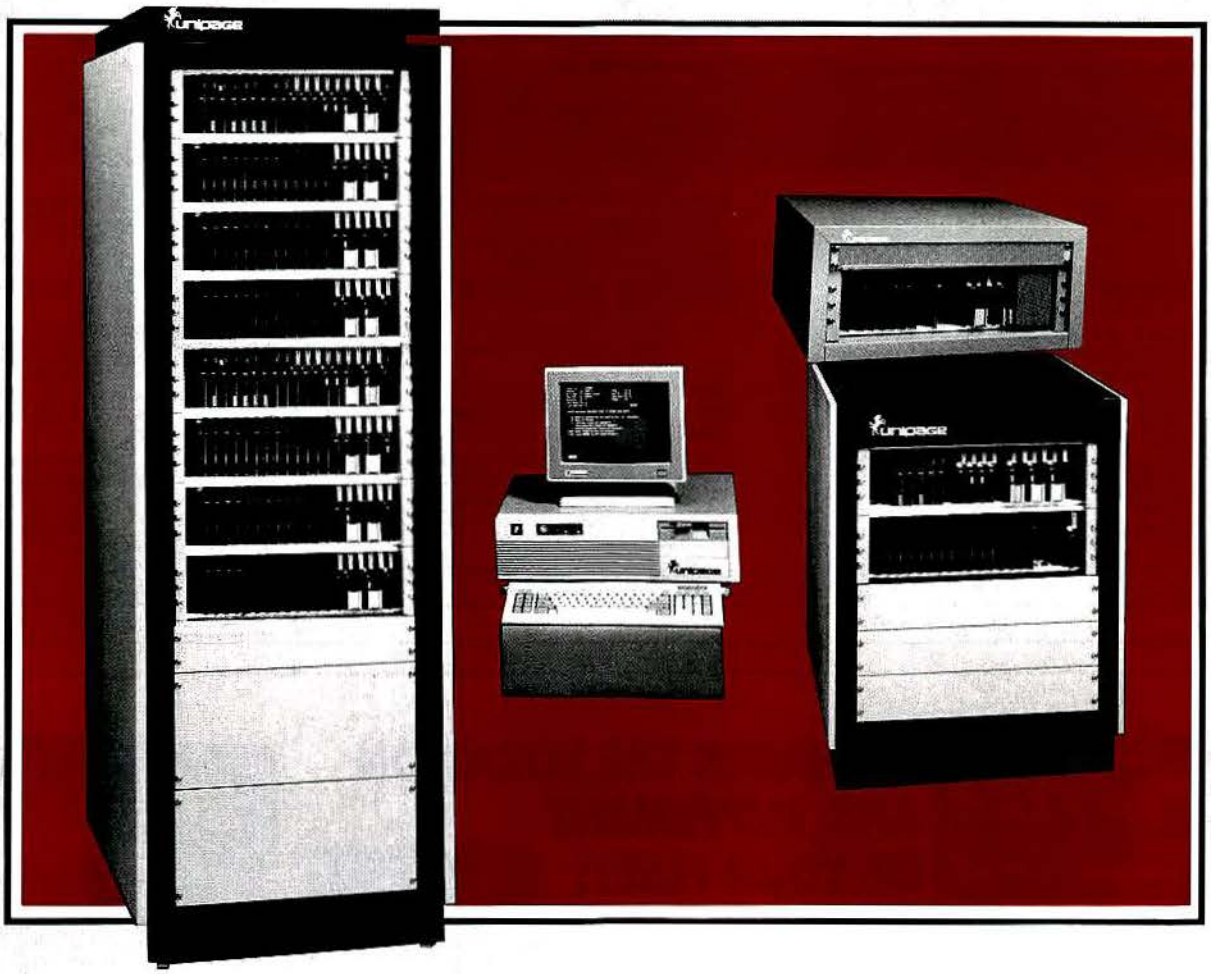
Solid-State Communications
Circle (211) on Fast Fact Card

References

1. Block, Roger R., "Lightning Protection For Side-Mounted Antennas," *Mobile Radio Technology*, September 1984.
2. Block, Roger R., "Guy Wires Lower Tower Inductance, Reduce Lightning Vulnerability," *Mobile Radio Technology*, December 1984.
3. Block, Roger R., "How To Get the Best Ground for Lightning Protection," *Mobile Radio Technology*, May 1985.
4. Block, Roger R., " 'Ground Rules' For Lightning Protection," *Mobile Radio Technology*, June 1985.
5. Block, Roger R., "How To Build an 'Ufer' Ground at Radio Communications Sites," *Mobile Radio Technology*, December 1985.

unipage

Big or Small. . .We Make Them All



A Unipage System will not become obsolete as you and your paging terminal requirements change. From small to large OR large to small, Unipage has systems that will grow and transform to meet your needs. Unipage Systems are easy to expand. Unlike other terminals, our unique modular architecture allows components to be added or changed economically.

- Subscriber expansion to 2,048,000
- Trunk expansion to 1,920
- Message Manager — Voice and Numeric Replay
- Alpha messages to 1000 characters
- High efficiency Dynamic Digital output
- Up to 30 calls per second, per channel
- Restricted Agent programming
- POCSAG 1200 and 512 baud
- Secure remote programming
- Automatic memory backup
- Voice Prompting — per subscriber
- Talkback paging
- TNPP Networking

Unipage provides the most advanced technology available, long term growth, AND a price that you can afford. Give us a call today and let us show you how a Unipage product can be working for you.

UNIPAGE, INC.
1509 Falcon St.
Desoto, TX 75115
1-800-367-2864 or (214) 224-3509

Circle (46) on Fast Fact Card

6. Block, Roger R., "How To Install Low-Impedance Ground Rods and Connections," *Mobile Radio Technology*, January 1986.
7. Block, Roger R., "How To Ground Guy Anchors and Install Bulkhead Panels," *Mobile Radio Technology*, February 1986.
8. Block, Roger R., "How To Ground Racks and Equipment Hut Shielding," *Mobile Radio Technology*, March 1986.
9. Block, Roger R., "Protecting Remote Equipment From Power Surges," *Mobile Radio Technology*, May 1986.
10. Block, Roger R., "Tower-Top Radio Equipment Can Survive Lightning Strikes," *Mobile Radio Technology*, June 1986.
11. Block, Roger R., "Exploding the 'Myths' About Lightning Protection," *Mobile Radio Technology*, July 1986.
12. Block, Roger R., "Protecting Equipment From EMP Damage," *Mobile Radio Technology*, August 1986.
13. Block, Roger R., "Grounding Standard Guides Lightning Protection Installation," *Mobile Radio Technology*, September 1986.
14. Block, Roger R., "Dissipation Arrays: Do They Work?" *Mobile Radio Technology*, April 1988.
15. Carpenter, Roy B. Jr., U.S. Patent No. 4,180,698, Dec. 25, 1979.
16. Carpenter, Roy B. Jr., and Mark D. Drabkin, Ph.D., "Lightning Strike Prevention, a 15-year Historical Analysis," Lightning Eliminators and Consultants, Santa Fe Springs, CA, 1987.
17. Carpenter, Roy B. Jr., "Lightning Protection for Facilities With Electronics," Lightning Eliminators and Consultants, Santa Fe Springs, CA, a paper presented at the Energy Telecommunications and Electrical Association meeting, March 1988.
18. Claussen, Henry L., "Grounding, Bonding For Transient Protection," *Mobile Radio Technology*, August 1983.
19. Claussen, Henry L., "How To Keep Transients Out of Solid-State Radios," *Mobile Radio Technology*, December 1983.
20. Drabkin, Dr. Mark M., and Roy B. Carpenter Jr., "Lightning Protection Devices: How Do They Compare?" *Mobile Radio Technology*, October 1988.
21. Fawthrop, W. Gregg, "Dissipation Arrays," *Cellular Business*, April 1988.
22. Gillem, Vernon A., U.S. Patent No. 4,605,814, Aug. 12, 1986.
23. Gillem, Vern, "The Verda Lightning Deterrent," Lightning Deterrent Corporation, Chicago, 1987.
24. Hudalla, Donald F., "How to Fool Mother Nature," Lightning Deterrent Corporation, Chicago, 1987.
25. Kaiser, Bruce A., "Straight Talk on Static Dissipation," Lightning Master, Brooksville, FL, a paper presented at the Energy Telecommunications and Electrical Association meeting, March 1988.
26. Kaiser, Bruce A., "Static Dissipation Arrays: A Buyers' Guide," Lightning Master, Brooksville, FL, October 1988.
27. Keniston, James, "Effective Grounding for Cell Sites and Switches," *Mobile Radio Technology*, January 1988.
28. "The Lightning Prohibitor," Vir James P.C., Denver, 1986.
29. Little, Richard, "Surge Tolerance: How Does Your Site Rate?" *Mobile Radio Technology*, June 1988.
30. Nott, Ron, "Static Discharge to Cut Noise," *Radio World*, March 15, 1987.
31. Nott, Ron, "Lightning: Sources and Solutions," Cortana Corporation, Farmington, NM, a paper presented at a joint meeting of the Oklahoma Association of Broadcasters and the Society of Broadcast Engineers, February 1988.
32. Nott, Ron, "Ohm's Law For Lightning," Cortana Corporation, Farmington, NM, 1988.
33. Nott, Ron, "Prevent Lightning Damage on Antennas by Point Discharge," Cortana Corporation, Farmington, NM, 1988.
34. Sullivan, Thomas M., "How To Ground Coaxial Cable Feedlines," *Mobile Radio Technology*, April 1988.
35. Sulyma, Ihor Slim, "A Usable Understanding of Lightning," San Research, Northglenn, CO, 1982.
36. Tarney, Richard A., "Effective Lightning Deterrence: A Reality," TBA Marketing Specialists, Milwaukee, WI, 1987.

+ ADD

UP ALL THE CHOICES...SELECT FROM 65 NEW BATTERY PACKS, OVER 400 INDIVIDUAL BATTERIES.

− SUBTRACT

ALL DELAYS, BECAUSE WE SHIP SAME DAY IF YOU ORDER BY NOON!

÷ DIVIDE

YOUR PRODUCT FAILURE HEADACHES RIGHT OUT OF EXISTENCE. OUR RETURN RATE IS LESS THAN 2 PER 1,000.

× MULTIPLY

YOUR SATISFACTION FACTOR...

when you make **Multiplier**®

YOUR Power House for Communications Batteries

Let's sum up. Quality products. Proven performance. Unequalled dependability. With a commitment to service and support that's second to none. And the ability to design and manufacture custom batteries to your most exacting specifications. It all adds up to value. **Call or write for your copy of our latest catalog.**

Multiplier Industries Corp. Radio Circle • P.O. Box 630, Mt. Kisco, NY 10549 USA • 914-241-9510 • 800-642-2424 (outside NY State)

Circle (48) on Fast Fact Card

How small agencies can use mobile data communications

Advanced mobile data communications software lets users write forms and format the message switch, saving weeks or months of programming time. The cost savings brings systems within the reach of small organizations.

By Mary M. Peters

Many large organizations have turned to mobile data communications to supplement, or in some cases replace, analog voice communication over two-way radio. They find that data communication boosts:

- speed.
- reliability.
- spectrum efficiency.
- security.

Developments in mobile data communications message switch technology have brought these advantages within the reach of small organizations. The message switch consists of software, a computer and modems. It connects the various components of a mobile data communications system, which may include mobile data terminals, computer-aided dispatch (CAD) consoles and host computers and databases. (See Figure 1 below.)

In software, the advance is represented by programs designed so the user can reconfigure them to fit specific applications. The software does not need to be custom-designed by the vendor. It may be used without support from its developer.

Another advance is represented by the use of computers such as the IBM 286 or IBM 386AT. The use of general-purpose computers reduces hardware costs.

The new software and message switch equipment supports dispatch operations, mobile-to-mobile communication, host database inquiries, status updates and work order communication. The communications leave an "audit trail," meaning it is possible to track all transmissions and events.

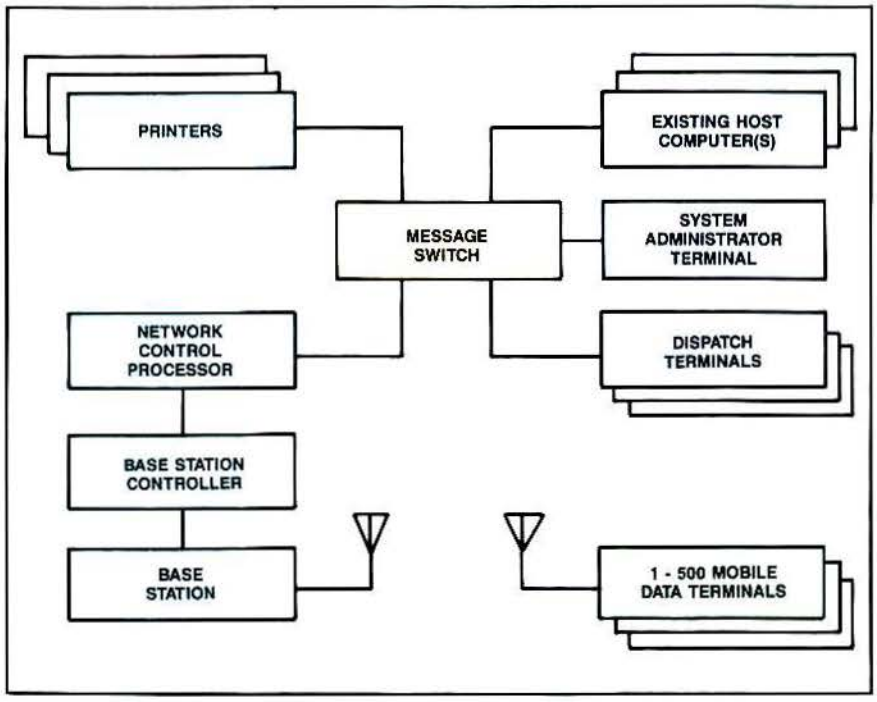


Figure 1. The message switch is the heart of the mobile data communications system. In single-dispatcher operations, the switch, system administrator terminal and dispatch terminal may be combined in one computer.

CAD interface

The new message switch provides a completely flexible computer-aided dispatch (CAD) interface: The mobile data communications system can be used with any CAD system on the market without further software development. Moreover, the data communications system can be used with any mobile data terminal (MDT) on the market. Even the simplest laptop computer can be used as an MDT, with the new software and message switch.

The mobile data communications system demodulates modulated data into its original digital format and sends it to the message switch. (Alternatively, the data may be passed through a conversion circuit that formats the information to allow faster processing at the message switch.) The message switch then passes the data to other mobile units or to a dispatcher, or reformats it and forwards it to a computer for storage.

The software was developed on a general-purpose, super-microcomputer

Peters is director of corporate sales and marketing for Hadron, Fairfax, VA.

that uses a Unix operating system. The combination makes it possible to move an entire mobile data communications operation onto hardware ranging from the IBM 286 or 386AT to the DEC Microvax II. Exactly what hardware each mobile data communications installation requires depends on the number of MDTs it must support and on the rate and quantity of data it must pass.

Universal software

Virtually the same software works for every user, such as public safety, utilities, courier services, taxi companies and warehouses. But each user's formatted messages differs from the others. For example, status update messages for police might include "in pursuit" and "on radar duty"; those of a utility might include "on route to job" and "on meter-reading assignment." The formatted messages are implemented with simple changes to characteristics and forms.

Configuring the mobile data com-

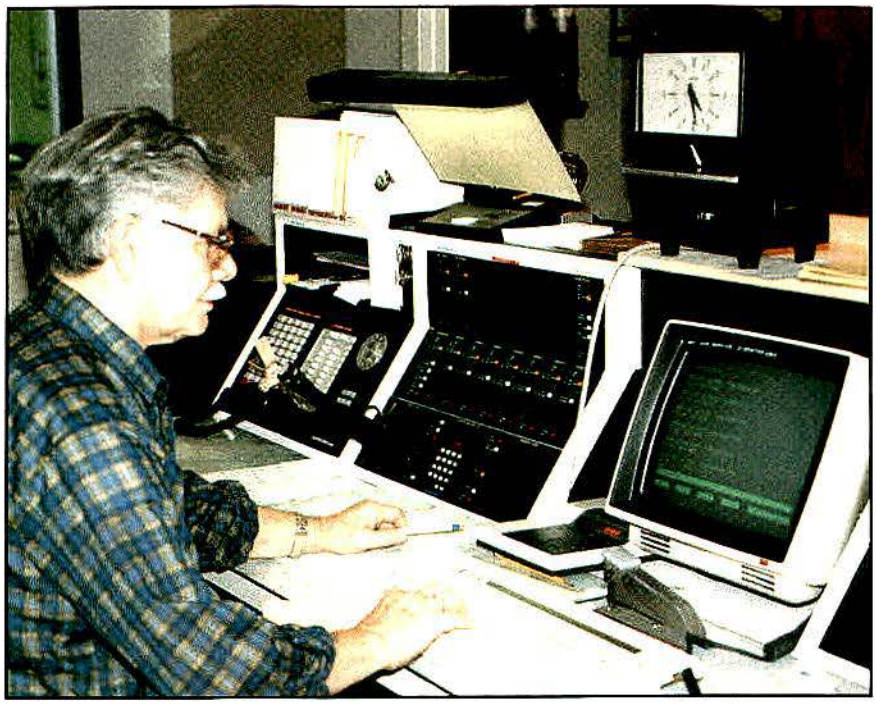


Photo 1. The Atlanta Gas and Light dispatcher reviews work order forms forwarded electronically from the service and distribution departments, selects a driver and sends it to the driver's mobile data terminal with the touch of a button.

munications software to communicate with a host database or CAD system has been simplified. On-site or remote host databases, such as corporate, local and state government, and the National Crime Information Center (NCIC), have different protocols. Forms used to access them differ widely.

With some mobile data communications systems, extensive custom software coding efforts are required. But with the latest message switch, the user only has to answer a list of questions, such as "What are the headers and trailers used with the form?" or "Is the protocol 2780, 3270...?" When the questions are answered, the appropriate link between the mobile data communications message switch and the host computer is enabled and communication is established.

The final step is the development of each form to be used in conjunction with the host computer. A limited, built-in word processor is used to write the forms, which are captured by the message switch and reformatted for compatibility with the host computer. For example, if a utility dispatches a truck, the driver could respond using this form:

TO: _____

ROUTE ORDER: _____

DATE: _____/_____/_____

LOCATION: _____

_____

MAP PAGE: _____

CUSTOMER: _____

WORK TYPE: _____

LOCATOR: _____

VEH. NO.: _____

DATE LOCATED: _____/_____/

REQUEST #: _____

MILES DRIVEN: _____

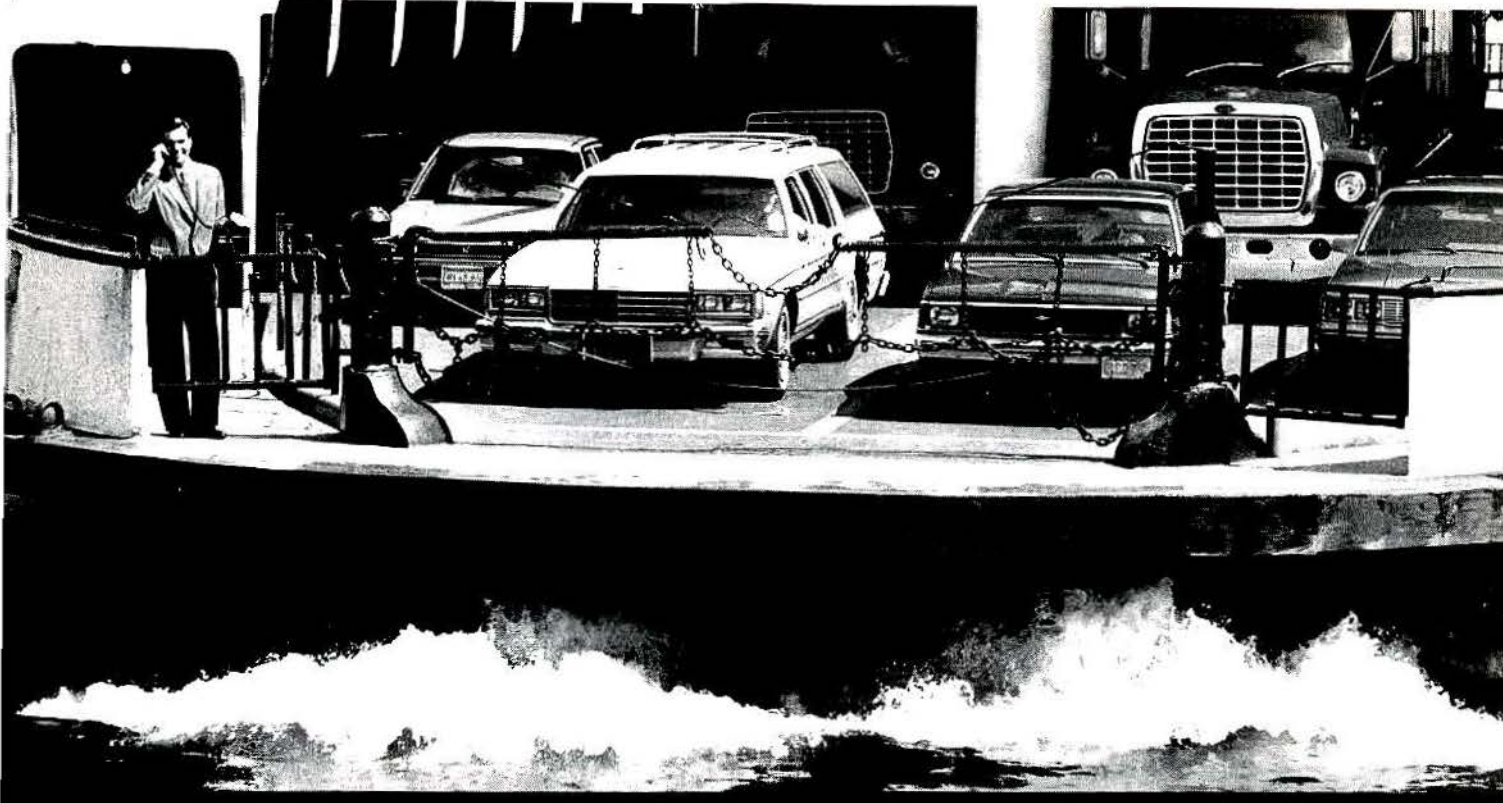
The driver fills in the blanks and sends the message. After the message switch reformats it, the message is sent to the remote host computer to update a database or to retrieve data needed to complete the transaction.

Forms may be developed and tested in a few days or weeks, depending on the number of forms.

User results

Catherine Land Waters, communications engineer and manager of the mobile data communications system at Atlanta Gas and Light, likes the result: "Since the mobile data system installation, channel congestion has been reduced by at least 50%, which represents a very sharp decline."

The utility makes use of formatted transmissions to drivers. Work orders used to be written and hand-carried to the dispatcher for voice transmission. Now orders are keyed into terminals in the service and distribution departments and transmitted directly to the mobile data communications system and displayed on the dispatcher's terminal. The order forms were designed by the utility, using the message switch soft-



Off-road vehicle.

The Panasonic EB-300w Series Cellular Mobilephone.

The Panasonic EB-300w Series is one of the most versatile car phones on four wheels.

Or two feet.

On the road, you'll find it's easy to stay in touch–with features that make it easy to transmit or receive calls. Features like wide-band capability with access to 832 channels, 40-number memory and speed-dialing. And with the hands-free option, it's easy to keep your hands on the wheel, and still take care of business.

The EB-300w Series is equally at home off the road, too. It converts in seconds to a compact, lightweight portable that packs a full 3 watts of transmitting power.

It's features like these that have made the Panasonic EB-300w Series one of the best-selling mobilephones on the market. And behind these phones is the level of marketing support you've come to expect from Panasonic. Our marketing programs, co-op advertising, point-of-purchase and promotional material will help you reach your customers. And the EB-300w Series is backed by a limited 3-year warranty supported by a wide network of authorized Panasonic mobilephone service centers. If you'd like more information on Panasonic mobilephones, just call 201-348-7933.

Your customers will find the Panasonic name is something they can rely on whether they're on the road, or off the road.

Panasonic

Panasonic Industrial Company
Telecommunications Division

Circle (51) on Fast Fact Card

Photo 2. Using a form designed on the message switch word processor, Kansas City, KS, police ready inquiries for the National Crime Information Center database.

ware. The dispatcher assigns the order to a worker and sends it with the touch of a button. (See Photo 1 on page 55.) "Because the operation is streamlined, it is much faster," Waters said.

Lt. James Bishop, commander of the communications unit at the Kansas City, KS, police department, used the message switch to design forms used by patrol officers to make inquiries of databases. Among the databases are vehicle records maintained by state agencies and criminal records maintained by state and federal agencies.

"Previously, the department was averaging 52,000 inquiries per month," Bishop said. "Each inquiry was handled by the dispatchers. With MDTs in place, we have seen an increase of approximately 15,000 inquiries per month. The combination of less channel congestion and direct access to databases accounts for the increase in inquiries." (See Photo 2 above.)

The lieutenant noted a direct correlation between the increased number of host inquiries and the total number of arrests and improved revenues from parking ticket payments. "Traffic units now have the mechanism and time to run a check with the NCIC and the motor vehicle administration when they pull over a car for a violation," Bishop said. "Without mobile data communications, many of these checks could not be done in the time available."

Users such as Atlanta Gas and Light and the Kansas City, KS, police can design their own system according to individual requirements. Upon initial installation, the system is configured according to the user's criteria. A detailed training session is conducted to make the user thoroughly familiar with the system.

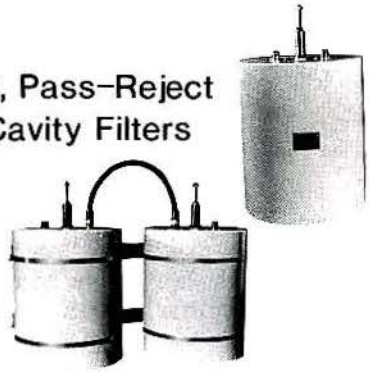
Thereafter, the user makes system modifications simply by changing certain characteristics. The message switch leads the user through questions and answers that reformat the system to reflect the necessary changes.

The user is responsible for product modifications rather than relying on a vendor. This self-reliance reduces the cost and time required for system changes. The vendor is always there to offer support when the user desires it.

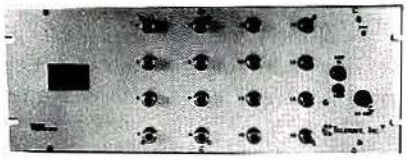
TELEWAVE'S "PROBLEM SOLVERS"

Transmitter Combiners • Receiver Multicouplers • Monitor Equipment • Test Equipment • Ferrite Isolators and Terminations • High Q Cavities and Filters • Duplexers • Systems Engineering

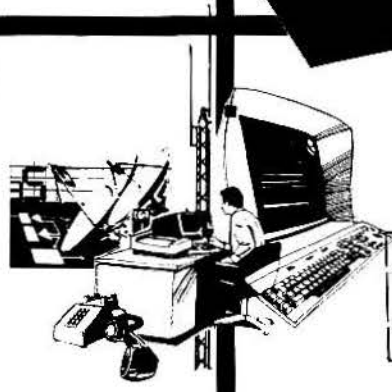
Bandpass, Pass-Reject & Notch Cavity Filters



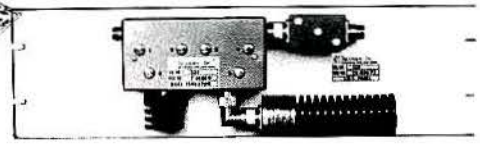
Transmitter Combining



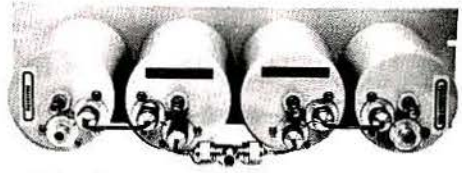
Receiver Multicoupling



IM Suppression Panels



R.F. Power Monitoring



Duplexers & Preselectors

GSA Number 00K86AGS0646

Telewave, Inc.

(415) 968-4400

1155 Terra Bella Ave., Mountain View, CA 94043

(800) 331-3396 FAX: (415) 968-1741

TWX 910-379-5055

How to correct errors in mobile data transmission

The largest two-way radio system, the Advanced Train Control System, will use Reed-Solomon forward error correction to boost range and reliability. You can use error correction to improve your system's coverage, too.

Dr. Peter F. Driessen

With more and more two-way radio systems relying on data transmission, ways to send that information quicker and more reliably become important.

Public safety users must squeeze lots of traffic into a limited number of channels. The faster the traffic moves, without errors, the better the communications support for law enforcement officers, firefighters and emergency medical service professionals.

Private system operators fall into two categories: those who operate systems to support their principal business, and those who offer communications service to others (specialized mobile radio [SMR] system operators, for example). Both groups have a stake in making their systems more efficient, either to place more traffic on a crowded channel, or to serve more customers.

Public systems support data transmission, too. For example, laptop computers can be plugged into cellular telephones to send and receive data. Mobile telephone customers pay for airtime, so efficiency translates into savings for them and a competitive edge for those who offer them the solution.

Users enjoy potent advantages with mobile data transmission:

- They move information faster and more accurately than is possible by voice.
- Messages may be stored conveniently for recall and unattended operation.

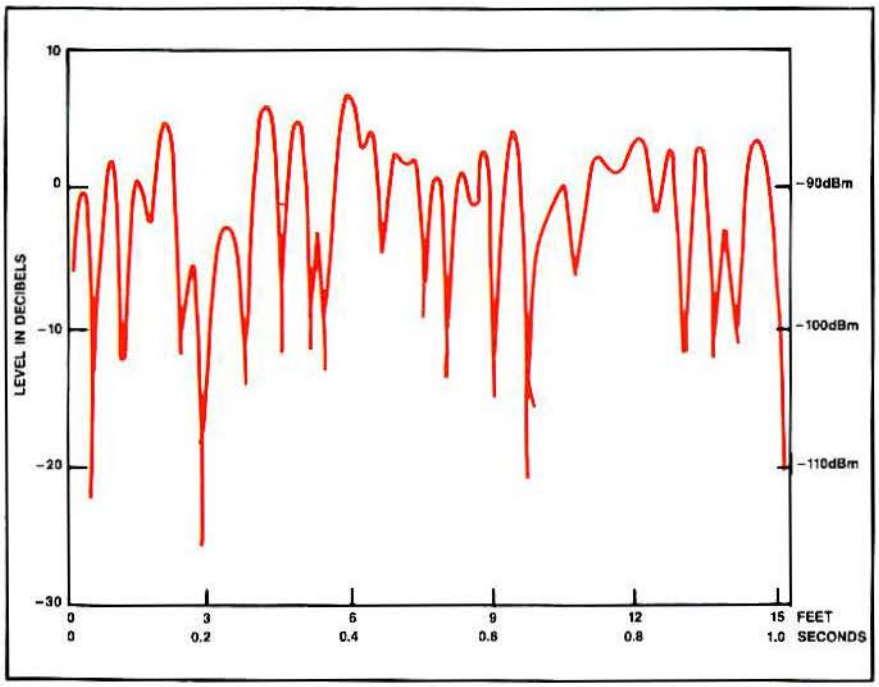


Figure 1. The Rayleigh fading envelope for a 900MHz mobile traveling at 10mph shows three fades below the −110dBm receiver threshold during a one-second interval. Fades below the receiver threshold cause errors in received data; Reed-Solomon codes can correct them.

Train control system

North America's largest two-way radio system, the Advanced Train Control System (ATCS), is about to be built. Operating at 900MHz, it will include 3,000 base stations and 30,000 mobile units on six channels. Powerful Reed-Solomon forward error correction will boost the system's data communications speed and reliability.

Actually a family of correcting codes, the proper Reed-Solomon code can be selected to suit the application.

Why is error correction necessary? Mobile radio signals fade, and noise on a channel interrupts communication. With voice communication, fading and noise may only cause annoyance, unless they are severe. With data transmission, information transfers so quickly that a split-second of fading or noise can garble letters or words and strings of numbers. The result may be a useless message, or incorrect entry or retrieval of numerical information. The consequences could range from trivial to tragic, depending on the circumstances.

Forward error correction reconstructs error-filled messages upon receipt so they need not be retransmitted. With error correction, radio or mobile tele-

Driessen is president of Datawave Communications, Sidney, British Columbia (604-656-9980), and he is a member of the faculty at the University of Victoria, Victoria, British Columbia.

This communications test set goes from factory to field!

Pile the battery-operated and light weight STABILOCK 4031 into a jeep and take it to a mountaintop bay station. Its 2 μV RF sensitivity even allows off-air measurements! Or take full advantage of versatile built-in test routines, 100 stored panel setups, and integral IEEE-488 interface for factory servicing and calibration.

Other features include:

- Cellular capability
- Duplex demodulator
- Off air measurements
- Program storage
- Hi-resolution zoom graphics
- 1000 MHz spectrum analyzer

Let our 25 years experience in radio communication measurements make your job a little easier.

Call today for a demonstration of the exciting 4031.

Schlumberger Instruments

20 North Avenue Burlington, MA 01803
Telephone: (617) 229-4825
Toll Free (Outside MA): 1-800-225-5765.

Schlumberger

Circle (54) on Fast Fact Card

phone system coverage improves because units may communicate data when they are in areas with poorer signals subject to more fading and noise.

Fading

In a mobile environment, a signal fades because it is scattered by buildings, hills and other objects, and its components arrive at the receiver via multiple paths. *Multipath* fading results because multiple signal components add and subtract strength from one another as their amplitude and phase relationships change. The audible effect is bursts of noise at rapid intervals.

Whenever the fading signal falls below the receiver's sensitivity threshold, noise bursts are heard.

Light seen through a picket fence appears to flicker as the observer moves past. The light's rate of flicker approximates the rate of fading heard on a two-way radio in a moving vehicle, so some refer to the fading as *picket-fencing*.

Figure 1 on page 60 shows the changes in 900MHz received signal strength recorded in a vehicle moving at 10mph. Notice that the fade depths are not uniform. The fading pattern is called Rayleigh fading because the signal amplitude follows a Rayleigh distribution described by mathematical formula.

If, in addition to the reflected paths, the signal also reaches the receiver via a line-of-sight path, the fading is less severe—Rician fading.

Whenever the fading signal falls below the receiver's sensitivity threshold, noise bursts are heard. Their number and duration depend on the average signal strength. The lower the average signal, the more frequent and the longer are the noise bursts. For given levels of probability, the number of fades and their duration can be calculated using mathematical formulas and specifications that describe the radio system.

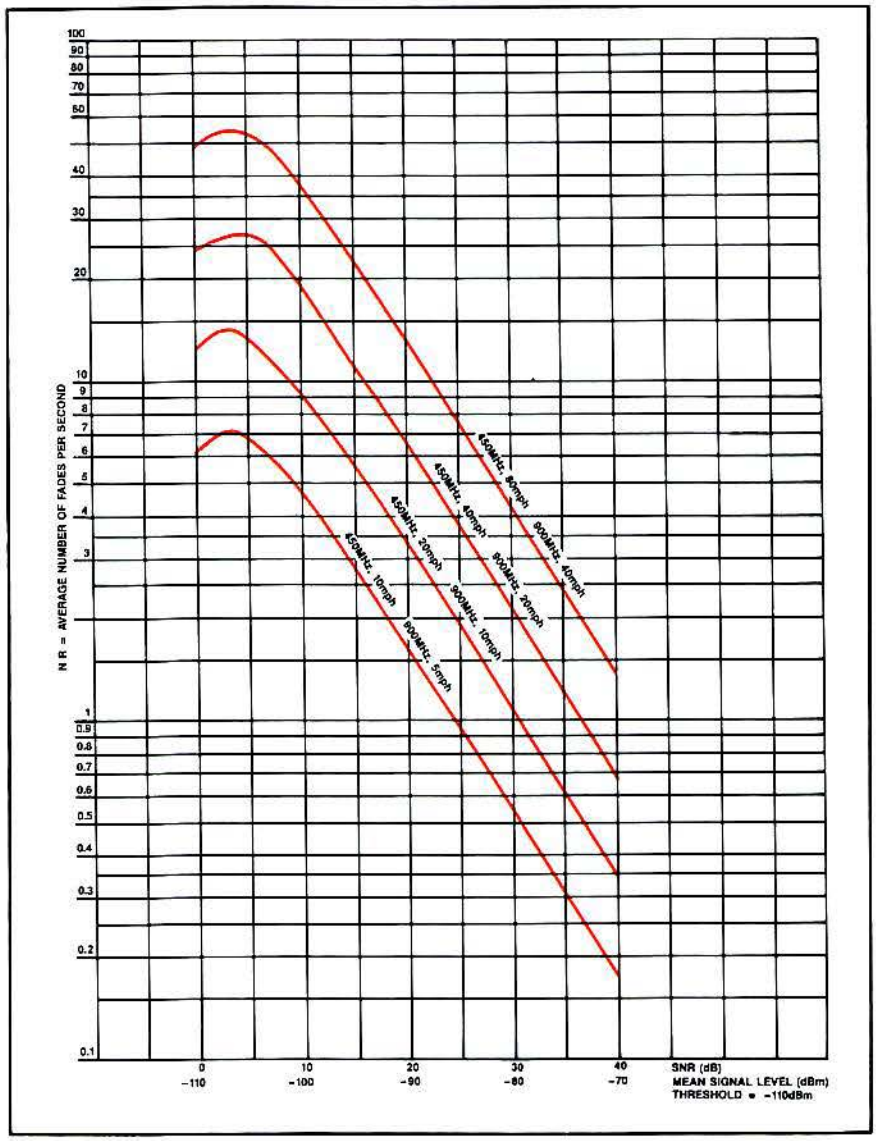


Figure 2. The average number of fades vs. the fade margin for given frequencies and vehicle speeds, and a typical receiver threshold of −110dBm.

Calculations have been made for 450MHz and 900MHz fading to derive the graphs shown in Figure 2 above and Figure 3 on page 64.

For example, with a vehicle moving at 20mph and a signal 14dB above the 900MHz receiver threshold, fades with an average length of 3ms will be heard an average of 13 times per second.

During data transmission, the number of bit errors fading causes depends on the fade rate and data rate. For example, at 4,800bps, a fade length of 9ms corresponds to an error burst of 45 bits.

A 200-bit message (about one line of 20 characters plus overhead) is about 40ms long at 4,800bps. At 13 fades per second, a fade occurs on an average of once every 80ms. Thus, every other message may be expected to suffer an error burst.

Principles

Forward error correction works by adding redundant, or "check," bits to the message. The processor uses these extra bits to find and correct bit errors, reconstructing the message. The amount of redundancy required ("overhead") depends upon the amount of fading and noise on the channel. Fading and noise can be predicted by analyzing the radio system, taking into account the radio frequency, transmitter power, distance

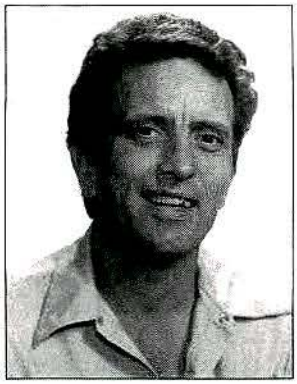
TONELOCK™ ENDS REPEATER TALKDOWN

ToneLock™ Means High Performance

ToneLock™ locks onto sub-audible tones even in the presence of loud, low frequency voice. The result is the virtual elimination of talkdown so common with other tone panels. ToneLock™ locks and holds onto tones even with a weak, noisy signal that leaves ordinary panels dropping out. This translates directly into reliable operation much farther from the repeater.

ToneLock™ Ends Customer Complaints

The last thing that anyone needs is complaints about poor coverage, jittery conversations or the annoying signal dropout commonly called talkdown. Use Zetron's Model 38 Repeater Panel with advanced ToneLock™ technology and put these problems behind you.



"There's nothing worse than getting complaints about repeater talkdown. The other tone panels that I've used are prone to talkdown. All of them. Zetron's ToneLock™ solved the problem."

Bill Holesworth
Business Radio, Inc.
Kennewick, Washington

Tests Prove ToneLock™ Extends Coverage

Now even a 4 watt handheld can capture the repeater where other panels would need a 15 or 30 watt mobile. Zetron's Model 38 Repeater Tone Panel with ToneLock™ decodes down to 2dB SINAD—that's 6 to 10 dB better than any competitive panel. In talkdown tests, the Zetron panel has zero dropouts under conditions that give other panels the flutters. And the annoying squelch tail of other panels is eliminated by the fast dropout that comes from properly decoding reverse-phase bursts.

Prove It To Yourself

We've designed a series of tests using a communications monitor and other basic test equipment that will show you just how good ToneLock™ really is. Call or write us today for your free copy of the test results. Let Zetron put technology to work for you.

Ask for:
Model 38 Repeater Panel

ZETRON

Zetron Inc.
2930 Richards Rd. S.E., Bellevue, WA 98005
(206) 644-1300 Fax: (206) 644-2661

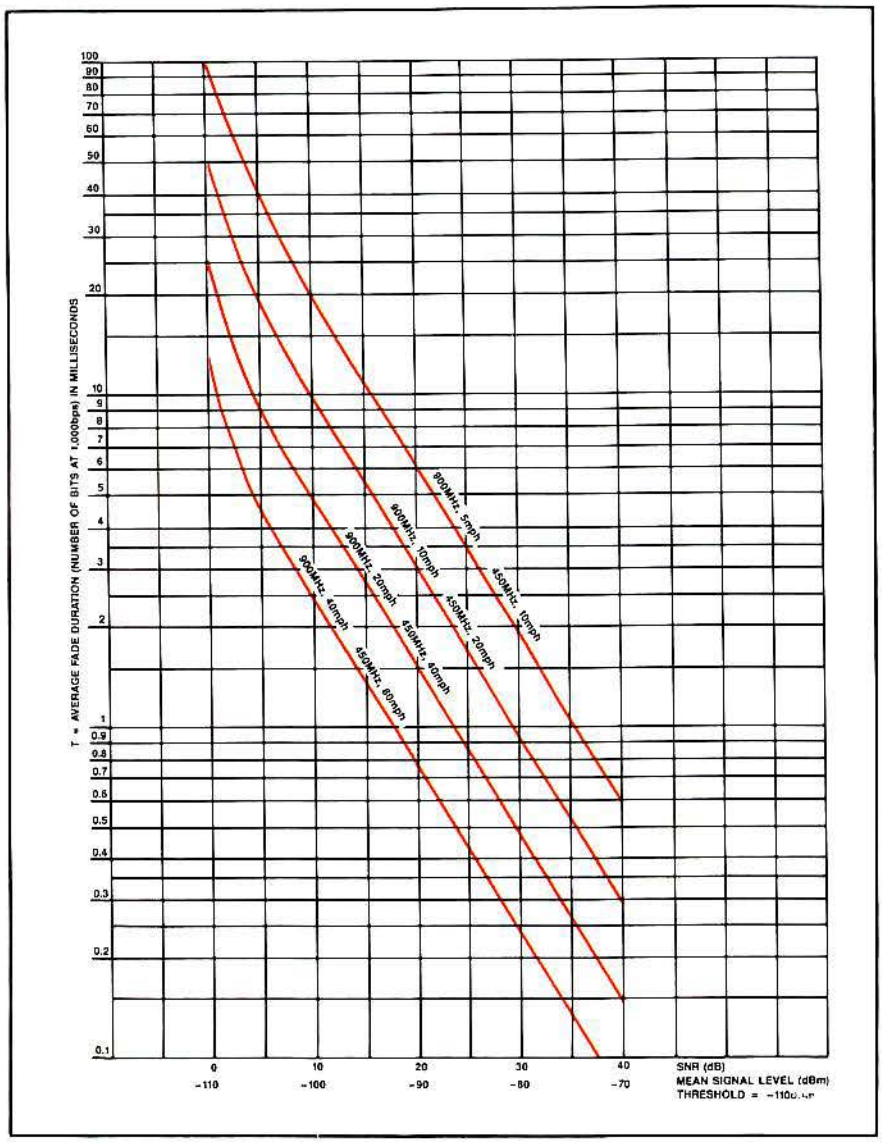


Figure 3. Average fade duration vs. fade margin for given frequencies and vehicle speeds, and a typical receiver threshold of −110dBm.

between units, speeds at which the units travel and other factors.

Reed-Solomon codes offer flexibility because the amount of overhead can be selected to fit the application. For example, if 10% overhead is added, then errors up to 5% of the message can be corrected. With 100% overhead, up to 50% of the message can be in error and the code still reconstructs the message. Once an analysis of the communications system has been made, the best code can be selected to suit the need.

Reed-Solomon codes find uses in deep-space telemetry, spread-spectrum modulation and compact discs, aside from mobile radio. The ATCS Specification 200 requires a Reed-Solomon code. Several mobile data terminal manufacturers use the codes.

Performance limitations

If a data block has more errors than the code can correct, decoding is unsuccessful and the message is retransmitted. Occasionally, the pattern of bit errors is such that the decoder falsely decodes what appears to be a valid message, even though it has too many errors. It is even possible to decode a message from random data. Such a message would contain an undetected error.

The probability of a false decode or undetected error with random data may be calculated. The probability of false decoding must be kept low to maintain accuracy. The probability is kept low by carefully choosing code attributes or by reducing the number of errors that the code is allowed to correct.

A typical false message probability that many find acceptable is one in 10^8 (100 million). This corresponds to one false message every year on average, assuming a system traffic rate of one message per second for eight hours every day and 30 million seconds per year.

Code selection

For a given application in mobile data, a Reed-Solomon code may be selected to match a desired message block length, vehicle velocity and signal level relative to the receiver threshold (with corresponding expected duration of fades and time between fades) and the allowable percentage of overhead bits, with due regard for the undetected error probability.

The specific code is chosen to meet a particular velocity and signal level. A practical system operates over a range of velocities and signal levels. A lower velocity and/or lower signal level results in longer fades that may exceed the code's error-correcting power. In that case, the message success rate may drop below the 95% specification.

Conversely, higher velocities and/or signal levels may result in a message success rate better than 95%.

Thus, the system designer must choose the signal level and velocity for which the system must meet the 95% success rate and must accept reduced performance at lower signal levels and velocities. The signal levels can be determined by a propagation study for the desired coverage area.

Software

A Reed-Solomon code can be implemented conveniently in software, using the mobile data terminal's microprocessor, and without adding any hardware. The software may be written in assembly language to obtain the fastest possible execution. The software consists of three routines, RSINIT, RSENCODE and RSDECODE.

RSINIT runs once when power is applied. It reads various tables from read-only memory (ROM) to random-access memory (RAM).

RSENCODE reads a message to be transmitted from a specified buffer loca-

tion, adds the check bits and stores the message in another buffer pending transmission.

RSDECODE reads a received message buffer, corrects errors and stores the decoded message, along with a status byte, in a buffer, ready for display or processing. The status byte gives the number of errors corrected or indicates a decoding failure if there were too many errors. The status information can be used for system monitoring and to develop statistics on radio link performance.

The RSENCODE and RSDECODE routines are designed to be linked easily into the user's application software.

Execution speed depends upon the specific code chosen, as well as the clock speed and instruction set of the microprocessor in use. At typical data rates used for mobile data, decoding is completed in real time, with sufficient processor time left over for other tasks.

Software testing

The performance of Reed-Solomon error-correcting software may be tested conveniently using acceptance test procedure (ATP) software designed for the purpose. ATP software exercises RSENCODE and RSDECODE routines and keeps statistics on the correction of errors.

ATP software contains these routines:

- generate (random or fixed message.
- RSENCODE.
- transmit.
- corrupt (add a random or fixed number of bit errors).
- receive.
- RSDECODE.
- compare (decoded message to original).

This set of routines may be repeated with different messages and error patterns. The execution speed may be measured with timers in the operating system or with a stopwatch. The probability of false decoding or undetected errors can be tested by feeding random messages to the decoder.

Coverage boost

The use of Reed-Solomon codes can be an effective way to extend the coverage area of a mobile data system without increasing RF power or antenna size.

References

1. Reudink, D.O., "Properties of Mobile Radio Propagation Above 400MHz," IEEE *Transactions of Vehicular Technology*, vol. VT-23, pp. 143-159 (1974).

2. Lee, Dr. W.C.Y., *Mobile Communications, Design Fundamentals*, Howard W. Sams & Company, Indianapolis, 1986.

3. Reed, I.S. and G. Solomon, *Polynomial Codes Over Certain Finite Fields*, J. Siam, vol. 8, pp. 300-304, 1960.

SIRSA opposes radio spectrum auctions, supports license transfer fees

On Oct. 20-22, 1988, the Special Industrial Radio Service Association (SIRSA) had its annual membership meeting. The SIRSA board of directors met, as did the Spectrum Management Systems (SMS) board of directors.

SIRSA is a trade association that represents licensees in the special industrial radio service. It coordinates frequency assignments for the service as an FCC-designated frequency advisory committee.

Mark Crosby condemned interservice frequency coordination practices that lead to 'manipulation by the whims of local coordinators.'

SMS is a wholly owned, for-profit, subsidiary of SIRSA. It was formed to engage in the sale and distribution of radio frequency utilization and relative administrative database management processing services. It sells its services to SIRSA and other frequency advisory committees.

Mark E. Crosby, president and managing director of the association, reported to the SIRSA membership and board meetings on various topics, including:

• *Spectrum auctions*—The association continues to oppose auctions of radio spectrum to raise federal revenue.

• *Transfer fees*—The association supports transfer fees for licensees who use spectrum for profit—a fee equal to 2% of the value of the communications equipment transferred. Others who use spectrum for "business enhancement" should be charged a flat fee.

• *'Instant' licensing*—SIRSA continues "to persuade" the FCC to implement its year-old proposal to permit applicants to begin operations following receipt of SIRSA's frequency coordination certification.

• *Interservice sharing*—Crosby condemned practices of other frequency coordinators involved in interservice sharing concurrences for the operation of secondary fixed stations at 450MHz. He said those practices lead to "outrageous" fees, delays and "manipulation by the whims of local coordinators." Crosby added, "We've been billed as much as $1,500" for a coordination request.

Crosby said he has been led to believe the FCC has "agreed to the sheer logic" of a year-old SIRSA proposal to eliminate the requirement for coordination concurrence for the secondary 450MHz operations. Nevertheless, SMS is constructing its own 450MHz database "so we won't be held hostage for lack of data."

• *Frequency coordination*—SIRSA is concerned that the poor performance of a few FCC-designated frequency advisory committees reflects negatively on the rest. "We learned that the FCC was giving serious consideration to releasing a notice of inquiry to study once again all, and I mean all, of the issues concerned with its 1986 decision that certified SIRSA as a frequency advisory committee and that created the requirements under which we operate."

He said a paper was prepared to show how the frequency advisory committees could resolve remaining problems themselves. The paper, "Frequency Advisory Committee Practices That Jeopardize Effective Spectrum Management," identifies the problems as "speed of service, single nationwide point-of-contact and excessive fees."

• *FCC audit*—On Sept. 29, 1988, the FCC responded to a procedural audit of designated frequency coordinators it conducted in 1987 by asking more questions of eight frequency advisory committees, including SIRSA.

The FCC described SIRSA's fee schedule as discriminatory. Although SIRSA has been charging all coordination applicants $90, if the applicant is a SIRSA member, the association has been crediting $50 from the applicant's membership account toward the coordination fee. The credit applies if the member paid dues within the previous 12 months and only for the first coordination request during those 12 months.

The FCC called the credit a discriminatory "discount." Although Crosby disputes the FCC's contention that the credit is a discount and discriminatory, he told the SIRSA board of directors, "Let's face it, if the commission believes we have an image problem with our frequency coordination fee schedule, we need to fix it."

SIRSA has implemented a revised fee schedule: During any given year, members and non-members alike pay the same frequency coordination fee of $90 per coordination request plus $20 for each fixed station. In the following year, SIRSA will credit $20 for each document processed the previous year for a member toward that member's annual dues.

"Using the computer, we will track the number of coordination documents we processed the previous year for members. For every document we processed the previous year, we will credit that member $20 toward its membership. If SIRSA chooses on its own to reduce that member's dues the following year, it should remove any question of discrimination regarding the coordination fee schedule," Crosby said.

• *New headquarters*—By March, SIRSA and SMS will relocate to leased office space in Ballston, VA.

Among topics covered by SIRSA general counsel Wayne V. Black in his address are:

• *FCC licensing and rulemaking delays*—Black explained constraints placed on the FCC by the fiscal year budget that began Oct. 1, 1988: "We expect the new budget to impact staffing so that application processing backlogs may expand and rulemaking activity fall to an even lower level than we are currently experiencing."

Of equal or greater importance, according to Black, is that SIRSA "cannot foresee any improvement in the commission's ability to enforce many of its rules so that, for example, special industrial licensees could expect to receive

improved performance from their two-way mobile radio investment."

Regarding future spectrum allocation for two-way land mobile use, Black said: "The picture is not particularly rosy."

• *220MHz band*—Black said he expects the FCC Office of Engineering and Technology to take the next step in the 220MHz to 222MHz rulemaking proceeding in early 1989. "This next phase will deal with the manner in which the spectrum will be shared with the federal government, the development of specific rules and the frequency coordination procedure to be followed," he said.

Crosby later commented that he hoped the special industrial radio service would be allocated frequencies from the new band. He envisioned a pattern similar to recent 800MHz allocations: part of the band to business radio, part to public safety radio and part to industrial and land transportation radio services.

Wayne Black on future two-way spectrum allocation: 'The picture is not particularly rosy.'

David Leach, a member of the House Energy and Commerce Committee's professional staff, delivered the luncheon address. His speech covered spectrum regulation, spectrum auctions, license transfer fees and possible recess appointments of two commissioners.

"You don't want Congress involved in regulating spectrum," he said, "because:

(1) what Congress gives, it can take away.

(2) there are no protections."

By "protections," Leach referred to administrative procedures regulatory agencies such as the FCC must follow, including rulemaking notices; comment periods; reply comment periods; and consideration of petitions procedures Congress does not have to follow.

He cited the FCC reallocation of 2MHz of the 220MHz to 225MHz amateur radio band to land mobile radio. He said amateurs lined up 90 co-sponsors for a House bill to direct the FCC to restore the band to amateurs. "The effort ended with the passage of a Congressional Resolution that the FCC should recognize the contribution of hams," Leach said.

"Relations between Congress and the FCC are as bad as they have been in 50

years," he said. "Every FCC decision is reviewed. The current chairman of the FCC has repeatedly thumbed his nose at Congress. Every time he does, my boss (U.S. Rep. John Dingell, D-Mich.) says, 'I want to make it a painful experience for him.' "

David Leach: 'The FCC doesn't want to do its job. It wants to take the easy way out.'

Leach said the reason Congress scrutinizes FCC actions is because "the FCC doesn't want to do its job. It wants to take the easy way out: 'Let's sell spectrum to the highest bidder.' But Congress opposes auctions."

Leach explained why Congress opposes spectrum auctions:

(1) Auctions would add an extra cost to new businesses.

(2) The additional cost would reduce American business' competitiveness on a global basis.

"Why add a price tag to tools that aid competitiveness?" Leach asked.

Leach spoke about the prospects for auctions and another proposal to raise revenue—license transfer fees—in the next session of Congress:

Auctions—"I don't think Congress will permit auctions to happen."

Transfer fees—"You don't want to use fees that impede communication."

Leach said that on Wednesday, Oct. 19, the FCC security detail was told to make the two vacant FCC commissioner offices ready for recess appointments. "On Thursday, they were moving boxes in." But Leach said he did not know the identity of the possible recess appointees.

Telocator approves private carrier membership

The Telocator board of directors has voted to open membership in the association to private mobile communications carriers.

The move requires amendment of Telocator's bylaws and must be approved by the full membership. Association president William Hotes said Telocator tentatively is planning a special meeting to consider the issue this month.

Hotes said the removal of regulatory distinctions between services offered by common and private carriers led the board to conclude that the industry could be represented best by a single organization.

Telocator initially opened membership to mobile service affiliates of wireline telephone companies more than a year ago. Since then, four of the seven regional Bell holding companies have joined the association.

George Burton dies

George Burton, 84, retired captain of the Contra Costa County Sheriff's Department in California, died Sept. 25. Burton, a communications consultant in Red Bluff, CA, was believed to be the first to establish a mobile radio repeater, which he operated in early 1940 on Mt. Diablo, which is centrally located in the county and towers 3,849 feet. (See "Public Safety Credited With Three Milestones," July 1988 issue.)

Brandle leaves E. F. Johnson

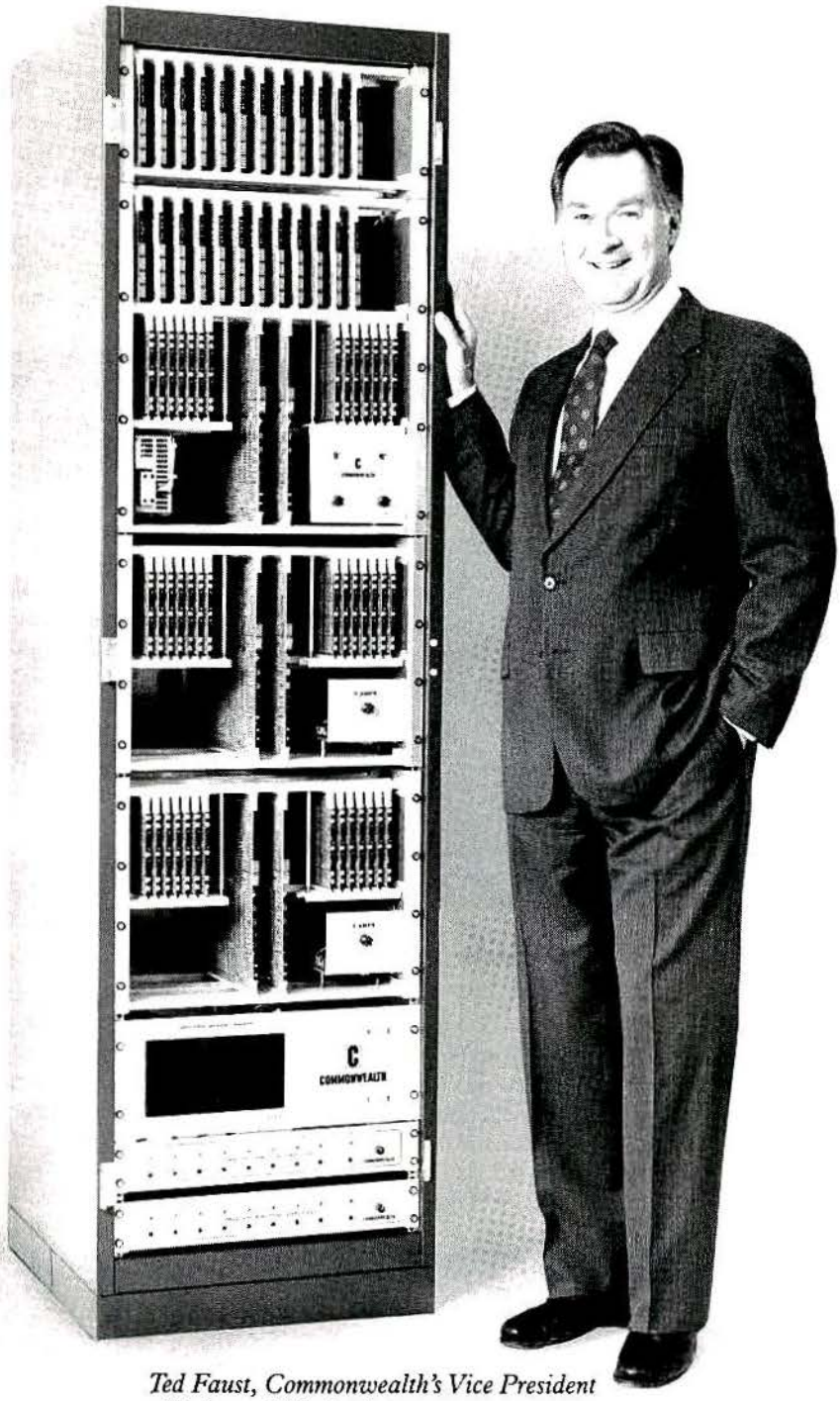
Bob Brandle, senior vice president of marketing for E. F. Johnson, Eden Prairie, MN, has left the company to become president and CEO for Network Communications, Eden Prairie. Brandle has been replaced by Alan Caron, who moves up from Inscan, a subsidiary of E. F. Johnson's parent, Diversified Energy.

VTS-IEEE names McClure president

Stuart Meyer, incumbent president of the VTS-IEEE, fastens the president's pin to the lapel of newly elected president George McClure of Martin Marietta, Orlando, FL.

The Vehicle Technology Society (VTS) of the Institute of Electrical and Electronics Engineers (IEEE) has selected George McClure of Martin Marietta, Orlando, FL, as its 1989 president. The selection came at the group's board meeting in Dearborn, MI, on Oct. 16-19, which was held in conjunction with the Convergence Conference. McClure has been a longtime member of the VTS board and succeeds incumbent president Stuart Meyer, a communications consultant based in Vienna, VA, and an *MRT* editorial advisory board member.

Talk To The Two Old Reliables In The Industry



Ted Faust, Commonwealth's Vice President of Sales and Marketing

If you're interested in purchasing paging equipment for your business or want to invest in an upgrade, you don't need a sales conversation. You need experienced, reliable professionals to analyze your business requirements. And in your business, you can't afford any down time. You need reliable service.

We hope you'll get good advice.

We hope you'll talk to the two old reliables in the paging industry—Ted Faust and the Mark series computerized paging terminals at Commonwealth Communications.

Both Ted Faust and Commonwealth entered the industry more than a quarter century ago. And together they've helped to shape the future of the communication industry.

Need to talk to a reliable?
Call 1-800-633-8844

Now DOC approved to CSO3

COMMONWEALTH
COMMUNICATIONS INDUSTRIES, LTD.

602 Lickinghole Road/P.O. Box 312, Ashland, Virginia 23005
(804) 798-9128, Fax #(804) 798-5114, (800) 633-8844

Circle (58) on Fast Fact Card

FCC officials debate flexible use of spectrum

Peter Pitsch
... advocates free-market approach to spectrum

Flexible use of spectrum was debated at the National Association of Business and Educational Radio's Oct. 9-12 Conference in Alexandria, VA. In a conference session, Peter Pitsch, chief of staff for FCC chairman Dennis Patrick, and Brian Fontes, FCC special assistant to commissioner James Quello, presented opposite views on spectrum. Pitsch delved into the free-market approach to flexibility and its advantages; Fontes countered that it would be detrimental to the industry for a variety of service providers to offer identical types of services.

Larger operations could capitalize on business radio operations, if allowed entry, due to more capital and technological repertoire, Fontes explained. They could force existing service providers out of business; the smaller operator could not compete with cellular, he said.

Pitsch, however, speculated that if the current practice of "over-rigid spectrum planning" continues, the industry will be faced with "too many channels in the wrong places." Fontes retorted that strict spectrum allocation is the backbone that molded the industry as it stands today. Providing flexible use may create an unstable market, he said.

Brian Fontes
... supports strict spectrum allocation

American Site Network finds antenna sites

American Site Network has been founded by Drunell Gross to offer antenna site location service. Gross uses a database formed during 12 years of antenna site selection consulting for major carriers. Sites can be located and secured for local, regional and nationwide paging, specialized mobile radio (SMR), improved mobile telephone service (IMTS), cellular mobile telephone and two-way radio, among other uses.

American Site Network is at 122 Second Ave., New York, NY 10003; 212-477-4777.

APCO region 28: Applications have window

The Region 28 spectrum planning committee, which is responsible for planning spectrum usage in the area from Harrisburg east in Pennsylvania, south Jersey and Delaware in accordance with FCC Gen. Docket 87-112, has a two-month window for receiving applications for spectrum in the additional 6MHz in the 800MHz band released by the FCC.

The window period starts at the first of this month and runs through Feb. 28. Interested parties should contact their APCO frequency coordinator to receive the necessary form and additional information.

APCO frequency coordinators for the region are:

- *Delaware*—Richard R. Reynolds, Delaware Office of Telecommunications Management, 821 Silver Lake Boulevard, Suite 108, Dover, DE 19901.
- *New Jersey*—Norman Coltri, New Jersey State Police, P.O. Box 7068, West Trenton, NJ 08625.
- *Pennsylvania*—John Rowntree, Department of Public Safety, 100 Grant St., Pittsburgh, PA 15219.

Unipage offers two-year warranty

Unipage, DeSoto, TX, has a two-year parts and labor warranty with all its paging terminal products. The warranty covers all components manufactured by Unipage and will be based on a board or component exchange program.

For the owners who purchased the extended warranty, the effective date of warranty will be extended another year.

Page-Com submits report on identity of customers sold used radios as new

Page-Com, Dallas, has submitted a report to the U.S. District Court of Indiana that identifies approximately 90% of its customers for two-way radios that possibly were sold refurbished units as *new.* The submission complies with a court order stemming from a complaint and motion filed by Ritron, Indianapolis, Sept. 2 and a court hearing Sept. 21.

The grievance names Page-Com as a defendant for allegedly selling used, repackaged radios to customers under the false representation that they are new. Page-Com distributes Ritron's Jobcom radios and also distributes a two-way radio manufactured by Ritron under the Page-Com name.

At the Sept. 21 hearing, Page-Com consented to stop selling the equipment in question and to notify all possible buyers of the refurbished units that an exchange would be made at no charge, according to Ritron attorney Philip Whistler. The regressive action was scheduled to take place within 30 days of the hearing.

In the report filed with the court and notarized Oct. 24, Page-Com president Gary Weber states: "Defendants have searched both Page-Com's computer records and invoice file and have been able to identify to date the customers for approximately 90% of the units at issue. In addition, defendants have begun addressing envelopes for mailing of the letter announcing the exchange of radios."

In the report, Page-Com states that as soon as the text of its proposed letter of notice to the potential customers is approved, it will begin mailing the letters immediately. "Defendants have produced more than 1,600 documents to plaintiff's counsel, including those which identify the customers, including addresses and sale dates, for the units at issue," the report states.

As of press time, a trial date had not been set, and Page-Com rectifications were not complete. Also, the suit alleges that Page-Com falsified FCC labels on units, and it is not known whether the FCC will investigate this possible violation.

ACT update

ACT Council meets, considers 1989 educational session topics

The Association of Communications Technicians (ACT) is a membership section of the National Association of Business and Educational Radio (NABER). The ACT Council met Oct. 12, 1988, in Alexandria, VA, as part of the 1988 NABER Fall Meeting. Council members discussed topics for educational sessions to be presented during NABER's 1989 Annual Meeting in New Orleans.

Topics discussed that may be developed into sessions of interest to technicians are troubleshooting and interconnect.

Information

For registration information about the NABER 1989 Annual Meeting, the Association of Communications Technicians and ACT benefits, call 800-759-0300.

Council member Thomas Dale, of Virginia Carolina Communications, Henderson, NC, said the suggestion was made to hold some of the educational sessions for technicians during the evening hours. "Although nothing definite was settled," Dale said, "it is a good idea to hold evening sessions to help to encourage ACT members in the New Orleans area to attend."

Council 'mission'

The ACT Council was presented with its charter and purpose, as approved by the NABER board of directors:

Charter: The ACT Section Council was created by the NABER board of directors to serve the special needs of land mobile radio technicians. The ACT Section Council was established to provide leadership representation to the section.

Purpose: The primary purpose of the ACT Section Council is to promote and support professional ethics and professional development, and to enhance quality performance by communications technicians; to inform technicians about technical, regulatory and other pertinent industry matters; and contribute to NABER's representation before the FCC, Congress and the public, and in particular:

(1) to suggest new ACT member benefits, products and services or general programs that will promote asssociation membership.

(2) to assess the impact of proposed legislation and regulation that may affect the technician community.

(3) to identify technician problems and needs that can be met by the association.

(4) to suggest educational topics designed to meet the needs of the ACT membership section and to suggest expert speakers for educational programs.

(5) to review data on ACT membership cancellations to help to determine the cause, and to assist in program development designed to overcome barriers to renewal.

(6) to actively promote through industry involvement the value of ACT membership.

(7) to serve in an advisory capacity to the *TechTalk* newsletter by suggesting or drafting articles, technical questions and book critiques of interest to technicans.

Council has focus

"The charter gives council members more direction and focus," said ACT Council vice chairman Gordon Forbes of Southern California Edison, Rosemead, CA.

"The charter spells out activities for council members, but we want to encourage ACT members to participate, too. For example, they can contribute articles and 'Tech Tips' to *TechTalk*. They are welcome to attend council meetings and to express ideas and opinions about ACT programs and activities," Forbes said.

The vice chairman said ACT no longer is in its "start-up" phase. "We have some long-term plans to think about, such as encouraging some new membership on the council."

The council discussed ways to promote professionalism in the industry, one of the purposes expressed by the charter. "We do not want to come across as though we are selling a product or service, even though our benefits are useful to members," Forbes said.

"Dues buy more than subscriptions to ACT publications, they buy membership in the only professional association for communications technicians. We want to encourage ACT professionals to contact one another, to forge network friendships and to keep abreast of technology at the grassroots level. That was the idea of ACT all along. Not just to have a council meeting twice a year, but for members to receive useful information and direction through *TechTalk*, *Business Radio*, NABER and ACT and by knowing one another, especially general members who need to come up to speed to become senior members," Forbes said.

Boosting membership

The vice chairman said membership in ACT as a professional society is one step in a technician's career development. "We discussed how to get more general members: to reach America's future technicians who come from the military, trade schools and the pool of amateur radio operators, to help them prepare for the certification test and to know when tests are scheduled."

The association communicates the advantages of professional society membership to prospective members through a brochure and letters.

Another brochure is sent as a follow-up to new members. It asks how they like the association and whether they receive publications on time, and for other feedback. "We talked about ways to encourage feedback," Forbes said. "We want all members to participate in their professional society by writing book reviews and 'tech tips.' "

Advertising

The council discussed whether display advertising should be accepted in *TechTalk*. "We want all the attention we can get from various publications, and we want publishers to know we are not in competition with them even though we print a newsletter," Forbes said. "We discussed whether accepting advertising in *TechTalk* would make us look beholden to anyone." The ACT Council vice chairman said advertisements would be a source of revenue beyond dues. The additional money could be used to promote ACT and to support more field work, such as sending representatives to amateur radio "hamfests" and to trade schools. "It might also make it possible to pay for top quality technical articles in *TechTalk*," he said. "Currently, we accept advertisements, but there hasn't been a flood of advertisers banging down the door."

Also on the subject of advertising, the council discussed whether *TechTalk* should accept classified advertisements from individuals seeking jobs and service shops announcing job openings.

Forbes said the ACT Council supports the "ACT Update" column published in *MRT*. "We do not want the column to discourage other publishers from covering ACT, nor do we want *MRT* to feel let down when we receive coverage in

other publications. We want to emphasize our professional society status. We want all publishers to feel comfortable in covering ACT."

Council member Donald Turney of Motorola, Pompton Plains, NJ, and ACT member Joe Gately of Gately Communications, Hampton, VA, also attended the meeting.

Publications

By now, senior members of ACT should have received their copies of the *TechTalk Plus* Fall issue. The newsletter supplement is issued quarterly.

The *ACT Directory* now is available. It lists more than 2,000 members for use as a networking tool. Each member receives a free copy.

Technician certification

Of those taking the NABER technician certification exam on Sept. 24, 1988, 64% passed. The list of those who passed appears at the right.

Certified technicians

On Sept. 24, 1988, 51 candidates for the NABER technician certification passed the exam:

Tod R. Cahill
Benjamin F. Childs
David J. Cross
Rory J. Cuneo
Jeffrey L. Day
Dominic D. Durnin
Davide Enbom
Christian Felereisen
Peter A. Field
Frederick E. Fitte
Robert M. Galassi
Richard A. Geving
Robert D. Gigliuto
James L. Greelis
Jeffrey E. Hamill
George Holt
Steven M. Johnson
Lisa M. Kahn
John O. Keller
Lee A. Keller
Myron D. Kissinger
Neal A. Kitzman
Casey S. Leasure
Lyle Little
Robert M. Marzari
Kevin M. Mathena
James K. Mercier
Todd E. Murdock
Kevin D. Nicholson
Peter M. Oparowski
Mark Oppenheim
Tommy L. Overcast
Armando Perez
Michael R. Peters
John H. Rhea
Ronald L. Rupert
Allen L. Schaver
Christopher Schwenn
Patricia P. Shepherd
Gerald H. Shoaf
Edmund P. Simonin
Steve R. Speed
Jan Stancel
Ken Sterling
Dan J. Stockner
Gerald L. Taylor
Garry F. Trimble
Vance B. Vehrs
W. Sylvester Waddell
Christopher A. Watson
Kent T. Whitehouse

Comments are filed with FCC in trunking standard inquiry

Last year, the FCC issued a notice of inquiry to elicit comments about whether it should require certain trunked radio communications systems to use a standard signaling protocol. A standard protocol would allow different manufacturers' radios to operate on any other manufacturers' trunked system. The inquiry specifically addresses the possibility of imposing a standard for trunked public safety radio equipment made for 6MHz of spectrum in the 800MHz band, spectrum the FCC allocated on June 24, 1986.

Here is a review of some of the comments:

• *Motorola*—"Disadvantages to setting a standard far outweigh the advantages," the company's comment reads. Among the advantages the comment cites are multiple sourcing and another level of interoperability.

Among the disadvantages are the time required to develop the standard; complexity of the standard; a standard would limit further innovation; a standard would contribute nothing toward interoperability with systems outside the 6MHz of new spectrum and those operating in conventional mode; a standard would produce inefficient operation; and a standard would place a hardship on licensees already using systems incompatible with the standard.

• *Associated Public-Safety Communications Officers (APCO)*—A standard would "impede further technological advances," APCO's comment reads. Instead, the association of public safety radio users wants competing manufacturers to agree voluntarily to offer optional, compatible equipment.

• *Bendix/King*—A standard would "provide the foundation for increasing the use of trunked channels for data transmissions." The company's comment reads that a standard would encourage more companies to offer equipment. The company offered as an example cellular standards that "have resulted in a competitive, growing industry. . . ."

• *Los Angeles County*—The county's comment points out that price reductions may result from adoption of a standard that encourages more suppliers to offer competitive equipment. But it reads that interoperability among different systems would not be enhanced greatly by a standard because many law enforcement agencies may not want others to use their systems.

• *North American Philips*—A standard "would permit fair competition in the marketplace for public-safety land mobile radio equipment," the company's comment reads. The comment brings up the interoperability question, saying that a standard would meet public safety agencies' requirements for communications with other agencies within and outside their jurisdictions.

FCC saddles San Bernardino with 'interface burden'

Public safety users in San Bernardino County in California have withstood protests about their proposed use of 12.5kHz offset channels in the 800MHz band. Among those who brought their protests before the FCC were conventional and trunked radio users.

In upholding its decision to permit public saftety communications on the offset channels, the commission placed its heaviest condition upon the public safety users: "If the county's system causes interference to existing users, the county will have to cure the interference," the federal agency's notice reads.

Forest Service rate hikes placed on hold until April

Responding to Congressional pressure, the U.S. Department of Agriculture's National Forest Service has delayed implementation of its new electronic site land use fee schedule until at least March 31.

Hikes of as much as 10 times current rates might already have become effective, were it not for successful lobbying conducted by the National Association of Broadcasters. It persuaded Sen. Pete Domenici (R-NM) to send a letter asking Forest Service chief F. Dale Robertson for a delay so Congress can hold hearings about the fees. Land mobile radio interests also lobbied for relief, but broadcast interests turned the tide.

Amateur radio operators already have won relief from the proposed fee schedule, based on the Federal Land Policy and Management Act of 1976. The law provides for waivers to users of federal land who provide benefits "without, or at reduced, charge."

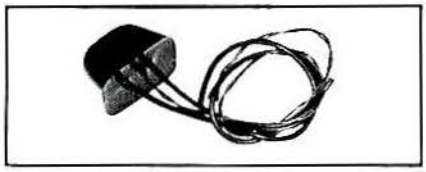
Broadcasters seek relief from the proposed fees under the same provision because they provide "valuable public benefits free to local citizens."

Remaining site users fall into three categories: common carriers, private radio system owners and providers of shared private radio facilities.

Reader's Choice

Of all the new products and services covered in the May 1988 issue of *MRT*, the ones reprinted here generated the most reader requests for additional information. If you missed them the first time, here is your opportunity to acquire more information on them: Just circle the corresponding Fast Fact number on the Fast Fact Card found in the back of this issue and mail the card to us.

High-gain pre-amplifier covers 20MHz to 1,000MHz



The RFX receiver, transceiver, scanner and instrumentation preamplifier fits inside existing units to offer 13dB gain at a noise figure less than 5dB. **Electron Processing** casts the unit in epoxy resins so it may be used outdoors or may be subjected to high vibration.

Circle (363) on Fast Fact Card

Portable scanner includes all bands and services

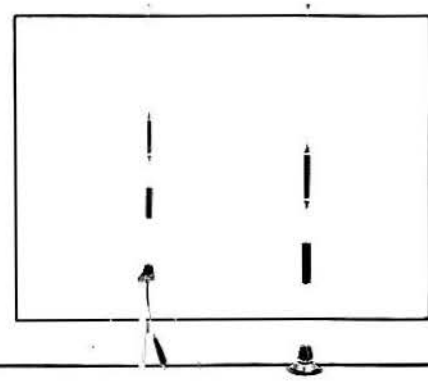
The AR800 portable scanning receiver covers 30MHz to 50MHz, 118MHz to 136MHz, 140MHz to 175MHz, 436MHz to 512MHz and 830MHz to 950MHz. The coverage includes police, fire and emergency bands, plus new services available above 800MHz. The **Ace Communications** unit comes with a rechargeable battery, charger, antenna and carrying loop.

Circle (362) on Fast Fact Card

Scanner antennas deliver improved 800MHz performance

Scanner antennas from **Antenna Specialists** deliver improved performance up to 1,000MHz. Models MON-52 (mobile) and MON-58 (base station) feature Micro-Choke to pinpoint resonance at 800MHz scanning frequencies and concentrate the vertical pattern at a low angle for maximum-range monitoring. The antennas cover 25MHz to 1,000MHz.

Circle (364) on Fast Fact Card



Trunked radio boasts 15W, 8-system capability

The LTR 8600 trunked mobile radio from **E. F. Johnson** features 15W output, eight-system trunking, system scan and conventional 800MHz channel operation. The dash-mount mobile has front-panel control and external EEPROM programming. The unit's die-cast chassis meets military standard 810 C and D.

Circle (359) on Fast Fact Card

Tone-remote console monitors as many as 6 sites

Model C-516 tone-remote console from **Vega** provides F1 and F2 monitor control of as many as six remote base stations. The control system features complete line-termination circuits for all six circuits and summing circuits to permit simultaneous monitoring of all channels.

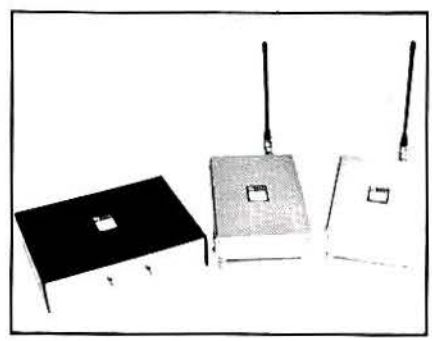
Circle (348) on Fast Fact Card

Lowband base radio offers 60W output

The TKB-620 lowband desktop base radio from **Kenwood** offers nine semi-duplex channels, modifiable to 16 semi-duplex channels. It has 60W output and spans 29.7MHz to 50MHz. Features include synthesized channels, TCXO, heavy-duty internal die-cast chassis, noise blanker and LED display.

Circle (361) on Fast Fact Card

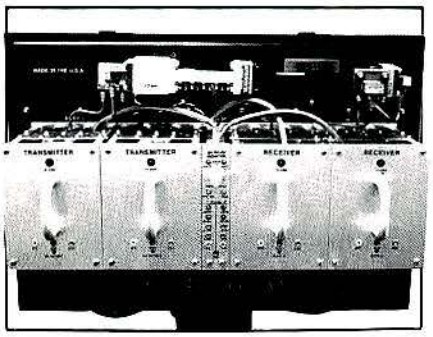
Radio modems are offered in simplex, duplex



Radio modems from **Solid-State Communications** used to provide wireless digital communications among personal computers, data terminals, peripherals and other computers are available for simplex and duplex operations for as far as 10 miles. Models can be used for pulse code modulation telemetry and remote control, as well.

Circle (355) on Fast Fact Card

Microwave line supports short-haul applications

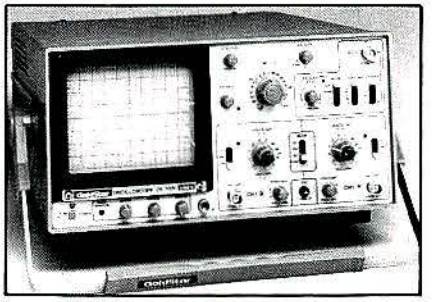


A line of microwave products from **Microwave Networks** supports short-haul solutions for common carriers and private users with medium capacity requirements. The MicroNet 18 line of products are ideal for last mile or first mile communications links with tunable RF transmitter and receiver units. Products include radios for transmission of voice, data or video traffic.

Circle (354) on Fast Fact Card

Oscilloscopes offer scale illumination

Two oscilloscopes from **Goldstar Precision Company** features a 6-inch CRT display with internal graticule, scale illumination and photographic bezel. The OS-7020 is a 20MHz tester, and model OS-7040 is 40MHz. The units have a stable, low-drift design, TV sync separation circuit, X-Y mode, high sensitivity, calibration indicators, gold contacts and a steel case.



Circle (399) on Fast Fact Card

Nationwide pager features autodialer

With the MBS-88 nationwide pager from **Cue Paging Corporation,** users can verify system status, including out-of-range signal and low-battery indication. Messages can be reviewed in descending order of receipt. The unit has automatic backlit display and an autodialer, and it has storage capacity of five 12-digit messages.

Circle (391) on Fast Fact Card

Cellular marine antenna has 5dB gain figure

The CMS1182 is a three-element collinear cellular marine antenna from **Ora Electronics** that offers 5dB gain and features a signal emission pattern with no gain variations in any azimuth. The fiberglass and nylon antenna fits all standard 1-inch to 14-inch marine mounting hardware.

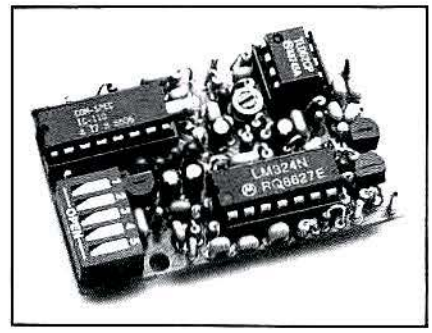
Circle (393) on Fast Fact Card

Trunked mobile contains 16-system select, scan

Circle (322) on Fast Fact Card

The LTR 8620 800MHz trunked mobile from **E. F. Johnson** offers 16-system select, system and group scan and EEPROM programming. The mobile operates on as many as 16 trunked systems with 20 channels per system or as many as 160 channels. The mobile has dual system capability and can operate in repeater talkaround mode. The trunk-mount unit has 35W output and meets military standard 810C.

Encoder-decoder offers custom memory programming



The TS-32P CTCSS encoder-decoder from **Communications Specialists** allows more tone versatility than earlier models. Service shops can specify any 32 tone frequencies from 1.5Hz to 255.0Hz. The unit features custom memory programing; it can be configured to provide multitone switching of as many as six tones without requiring diode networks. The encoder-decoder operates on 6Vdc to 25Vdc.

Circle (310) on Fast Fact Card

Portable data terminal weighs 3½ pounds

The 6100 portable data terminal from **Mobile Data International** offers a backlit screen and about 9½ hours of operation with a rechargeable Nicad battery pack. The unit is compact and weighs 3½ pounds. The 6100 has a 40-character by eight-line alphanumeric LCD.

Circle (319) on Fast Fact Card

Pocket power inverter produces constant 100W

The pocket power inverter from **Statpower Technologies Corporation** produces 200W peak and 100W constant power. The 12Vac to 115Vac power inverter features a low-battery alarm and has an automatic low-battery cutoff. It has a solid-state design, silent operation, high starting surge and regulated output.

Circle (430) on Fast Fact Card

Circle (68) on Fast Fact Card

Circle (69) on Fast Fact Card

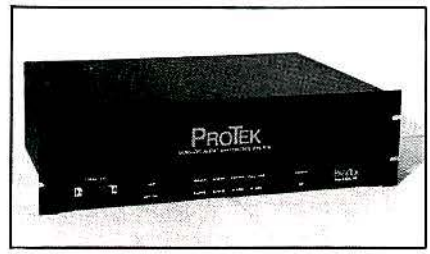
Precast buildings offer turndown roof design

A precast concrete building from **Easi-Set** features an upgraded turndown roof design that caps all walls and has a built-in drip feature. The design includes an adjustable overhead door holder and an aluminum entry. The steel-reinforced concrete building measures 10′ x 12′ with a 750-cu. ft. interior. The building is maintenance-free.

Circle (303) on Fast Fact Card

Alarm system monitors as many as 24 sites

The Protek-24 remote transmitter site monitor, control and alarm system reports more than 100 electrical points. The unit has automatic and remote controls and includes intrusion alarm, audio monitoring, transmitter power output and VSWR, on-the-air testing and site surveillance. The **PageTek** unit monitors as many as 24 transmitters.



Circle (308) on Fast Fact Card

Tone converter card yields various formats

Model 2491 tone converter card from **Lucas Ledex** changes DTMF code to CTCSS, two-tone sequential or four-tone paging and selective call formats. The unit monitors one contact closure and automatically sends programmed paging or selective call code when the proper DTMF codes are received, upon local keyboard entry or local contact closure.

Circle (405) on Fast Fact Card

Desoldering station operates on shop air

Model 7200 Endeco power vacuum desoldering station from **Leads Metal Products** operates on shop air—40-pound minimum required. It features a rapid vacuum that cools component leads quickly. The desoldering iron operates at 40W and idles at 20W. The nylon-coated station comes with eight tip sizes, cleaning tool, sponge and spittoon.

Circle (337) on Fast Fact Card

Digital paging decoder tests, analyzes terminal

The Interceptor system digital radiopaging decoder from **Statistical Control Systems** tests paging terminals and analyzes paging system statistics. The system integrates digital signal processor technology with a software package to form a diagnostic system.

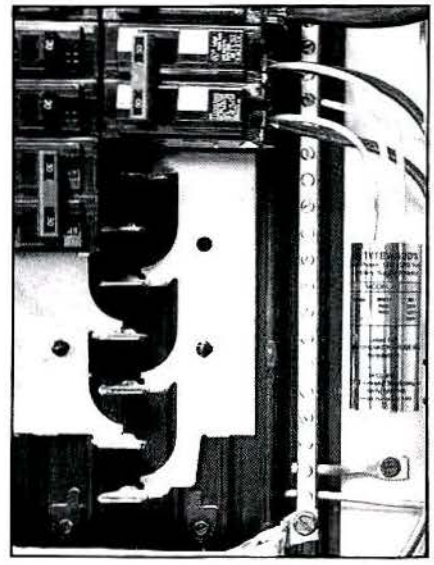
Circle (389) on Fast Fact Card

Ear mic is available for 5 groups of radios

The EM-150 Ear-Mike from **Magnum Distribution** comes with an interface cable that is dedicated to a single radio. The mic is limited to five groups of commonly used two-way radios. The mic is not a bone mic and it is not rated intrinsically safe.

Circle (401) on Fast Fact Card

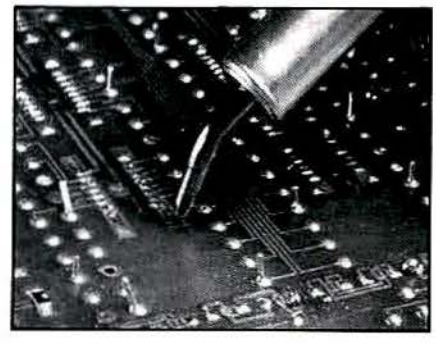
Secondary surge, lightning arrestors are offered



Eight models of UL-listed secondary surge and lightning arrestors are available from **Tytewadd Power Filters.** The arrestors install directly inside main or subdistribution electrical panels. One unit, or unit series, connected in one side of any two- or three-pole breaker protects the panel and electrical environment from surge and spikes as moderate as 130V to lightning-induced surges developing 15,000A.

Circle (266) on Fast Fact Card

Desoldering tips feature angled design



Desoldering tips from **Pace** incorporate an angled design, and the tips can be used with any of the company's solder extractors. A variety of inside and outside diameters are available. Tips come five to a package.

Circle (329) on Fast Fact Card

New products

Equipment shelters sustain fire, vandalism

Equipment shelters from **KONtek Industries** are made with fiberglass reinforced concrete or structural lightweight concrete. Portable and permanent buildings are available on a turnkey basis. The buildings require low maintenance and are vandal and fire resistant. Installation time is minimal, and the buildings are energy efficient. The buildings feature a modular design.

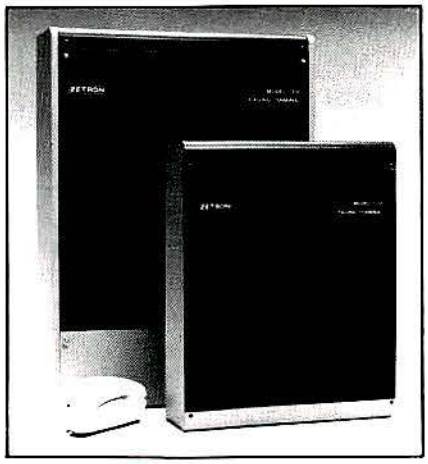
Circle (392) on Fast Fact Card

Portable is designated intrinsically safe

The LQH synthesized portable series radios from **Bendix/King** is rated intrinsically safe for Class 1, Division 1, Group D and nonincendive for Class 1, Division 2, Groups A,B,C and D when used with approved battery packs LAA0101, LAA0107 and LAA108. The portable is available with two or 14 channels with 2W or 5W output.

Circle (330) on Fast Fact Card

Paging terminals access nationwide service



Models 2100 and 2200 paging terminal from **Zetron** provide connection to Network USA's nationwide paging service on 152.48MHz. Digital display messages and tone-only alerts can be sent toll-free from any U.S. location to radio carriers equipped with the terminals and a satellite receiver from Network USA. The paging terminals are expandable and feature multitrunk applications.

Circle (343) on Fast Fact Card

Synthesized mobiles offer as many as 320 channels

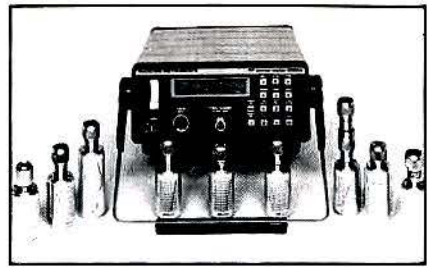
Trunk- and dash-mount synthesized mobiles from **Midland LMR** are available in 30MHz to 36MHz, 36MHz to 42MHz and 42MHz to 50MHz bands. The Syn-Tech II mobiles feature as many as 320 channels that are programmable in 16 groups. Other features include channel scan with dual priority, programmable switch, non-scan priority channel monitoring and scan expander that enables an operator to add programmed groups and delete or add back channels. RF output of 25W to 50W is adjustable.

Circle (351) on Fast Fact Card

Circle (74) on Fast Fact Card

Circle (75) on Fast Fact Card

Power meter spans 30kHz to 26.5GHz



Model 6960A power meter from **Marconi Instruments** has a frequency range of 30kHz to 26.5GHz and a power range of +20dBm to −70dBm, extendable to +37dBm. Dynamic range is 0.1nW to 100mW at frequencies from dc to millimeter waves.

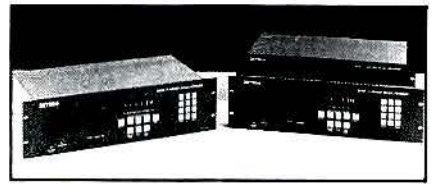
Circle (406) on Fast Fact Card

Base station handles as many as 9 channels

The TKB-720 VHF desktop base station radio from **Kenwood** uses EEPROM and provides as many as nine channels. RF output is 50W, and the radio features front-mounted speakers. The radio spans 150MHz to 174MHz and has an internal die-cast chassis. Other features include front-panel layout, LED display and modular construction.

Circle (411) on Fast Fact Card

Instant recall recorder logs as many as 32 minutes



Model 21 instant recall recorder from **Zetron** records and replays conversations on radio channels or emergency telephone lines. The unit provides as many as 32 minutes of message storage. It is available in a single housing or remote unit with a separate control panel. For dispatch centers with E911, model 21 can be equipped to record the ALI screen data along with voice conversation.

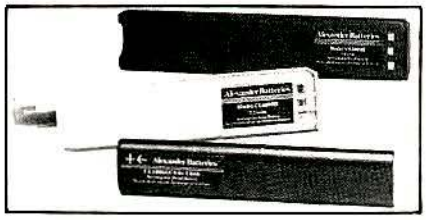
Circle (402) on Fast Fact Card

Data display pager can be coded, changed

The PGR5000 data display pager from **NEC America** allows operators to erase and change codes and user options in the field. It weighs 3 ounces and has a character memory of 120 digits or 12 separate messages as long as 10 digits each. An alert tone and LED light flash indicate an incoming message, which is displayed on an LCD display.

Circle (475) on Fast Fact Card

Batteries, analyzers offered for cellular



Cellular phone batteries, chargers and battery analyzers are available from **Alexander Batteries.** The CL10000AE battery is rated at 9.6V with 1.0Ah capacity and works with the Nokia Cityman cellular phone. The CL60000B, rated at 7.5V with 1.0Ah, and the CL4003B, rated at 7.5V with 1.0Ah capacity, fit Motorola 800 series cellular phones.

Tri-analyzers are available in three sizes: the TA6500-II, a six-unit model; the TA3500-II, a three-unit model; and the TA1500-II, a single-unit model.

Smart Charger battery chargers are available in three sizes, as well. The SM62000 is a six-unit model; the SM32000 is a three-unit model; and the SM12000 model is a single unit.

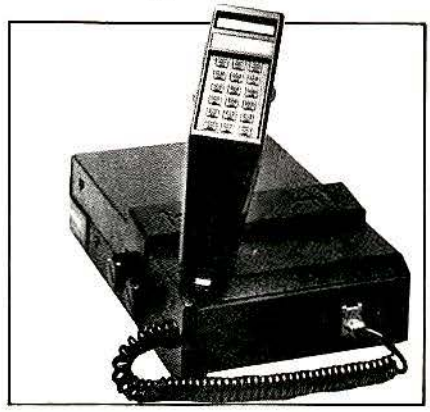
Circle (385) on Fast Fact Card

Digital voice repeater stores as many as 18 messages

The DVR 1001 digital voice repeater from **Spilsbury Communications** includes simultaneous record and playback; alphanumeric display; instant selection of desired message playback; and pause and save functions. The unit stores as many as 18 messages in standard or save modes. The repeater provides 5W audio.

Circle (315) on Fast Fact Card

Roaming mobile phone switches signaling formats



The advanced roaming mobile phone from **Telemobile** can switch signaling formats and automatically change scanning frequencies from telco to RCC in the assigned VHF frequency bands. The phone resembles a cellular phone and features alphanumeric display, memory, autodial and channel stepping controls. It comes as a cellular-style mobile or briefcase unit. As many as 10 signaling formats can be programmed with the option of having additional phone numbers programmed so that the user can have service in more than one area.

Circle (397) on Fast Fact Card

Trunking system has speech encryption option

The 16 PLUS digitally trunked radio system from **General Electric** is now available with GE's Voice Guard speech encryption as an optional overlay. Speech encryption may be added to any or all channels of mobiles and portables in the system. Signaling and encrypted speech use 9.6kbit datarate.

Circle (320) on Fast Fact Card

Synthesized portable offers 20 channels

The RSP500 VHF portable from **Regency Electronics** features 20 programmable channels. The synthesized unit offers track tuning, fast scanning and 5W RF output, switchable to 1W. It scans through its 20 channels at a rate of 40 channels per second. Digitally coded squelch (DSC) is built in, and the two-way hand-held incorporates surface-mount devices.

Circle (347) on Fast Fact Card

Lightning strike counter tallies current surges

The LSC-2 lightning strike counter from **PolyPhaser** plugs into a wall outlet and counts surges that exceed ±200V with 1 joule of energy. The unit is circuit breakered and non-resetable and has internal surge protection. It will count as many as 1 million surges.

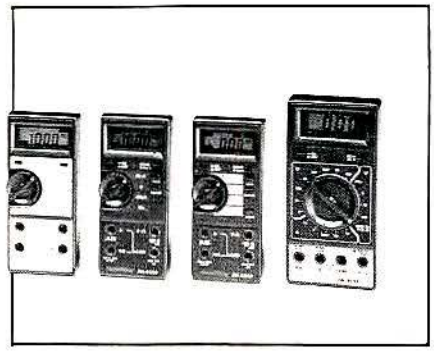
Circle (339) on Fast Fact Card

Cellular vehicular antenna attaches via suction cup

The Delta CMS808 cellular antenna from **Ora Electronics** is suited for temporary installations on glass surfaces inside the vehicle. It attaches with detachable rubber suction cups, and for permanent installations, it comes with a strip of two-faced tape. The aerospace-type design is unique to the antenna.

Circle (394) on Fast Fact Card

Digital multimeters have 10A resettable fuse



Circle (400) on Fast Fact Card

Digital multimeters from **Goldstar Precision Company** come in four models in the 6000 series. The models feature audible continuity, 10A resettable fuse, low-battery indicator, overload protection and ac/dc indicator. The DM-6133 is a manual, dial-type meter. Autoranging models include DM-6135 and DM-6235, which has a memory feature and selectable range. Model DM-6335 is an autoranging unit and has memory, selectable range and data hold memory features.

Bandpass filters fit 450MHz, cellular bands

Bandpass filters-preselectors from **Wi-Comm Electronics** are available for the 450MHz and cellular bands. BP451 is a helical filter, and the other three preselectors are interdigital. The preselectors are intended for base station applications and receiver multicouplers. Standard connectors are female; other connector options are available.

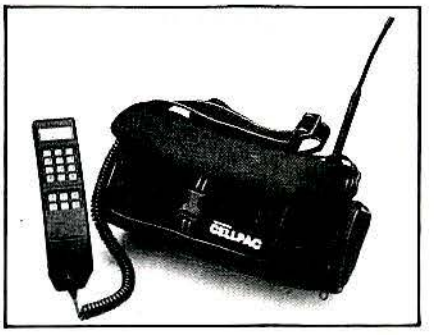
Circle (357) on Fast Fact Card

900MHz mobile provides privacy, call queuing

The GE-NET TMX mobile from **General Electric** offers immediate and automatic channel access, privacy, call queuing, and group and individual ID assignments. The 900MHz digitally trunked mobile operates on the GE-NET 900 system. Other features include rugged construction, 5W amplified speaker, four area-group combinations, multigroup decode, PC programming capability and power-up self test.

Circle (345) on Fast Fact Card

Transportable bag comes with or without battery



The Cellpac soft pack transportable bag from **Cellular Wholesalers** is designed for use with any Motorola Minitac or "KS" series phones. It is available with or without a battery, and the bag is water-repellent. Cellpac provides as much as 70 minutes of talk time or eight hours of standby. It comes with wiring harness, assembly plate, cigarette lighter adapter and charging cord.

Circle (426) on Fast Fact Card

Touch-tone phone doubles as alphanumeric terminal

A Touch-tone telephone can be transformed into an alphanumeric paging input terminal with technology developed by **Cue Paging Corporation** and **Fon-Ex.** The system uses single-stroke per letter entry of alphanumeric messages via Touch-tone phone keypads. Once a message is composed, a simple command allows the caller to transmit it directly to the paging switch for broadcast to the pager.

Circle (390) on Fast Fact Card

Dispatch 'trunking' format provides privacy advantage

The **Fujitsu** intelligent channel access (FICA) uses existing repeaters and Fujitsu Ten PLL mobiles to provide conventional repeater customers with mobile service similar to SMR service. From two to five repeaters can be configured to emulate trunked system operation; however, because the mobile, not a central processor, controls frequency selection, the channel access system does not fall under the RC's definition of trunking. Thus, it may be used with shared repeaters, regardless of the frequency band.

Customer benefits include privacy between mobile units, multiple channel access via "trunking," individual or group signaling, high-speed DTMF commands, busy-channel lockout and audio muting.

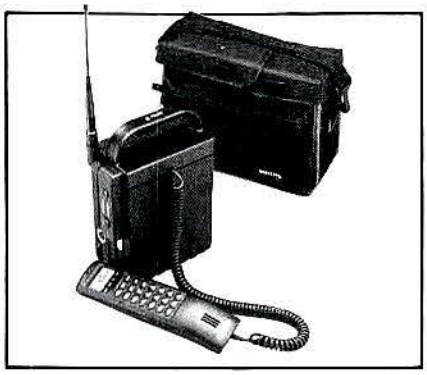
Dealer benefits include the upgrading of radio equipment in present use, a service more appealing to business users, and the ability to lock out mobiles. Repeater operators gain the increased capacity or grade of service that results from automatic channel selection.

Programming the dedicated DTMF ANI sequence is done via a DTMF keypad input on each mobile board.

Circle (386) on Fast Fact Card

New products

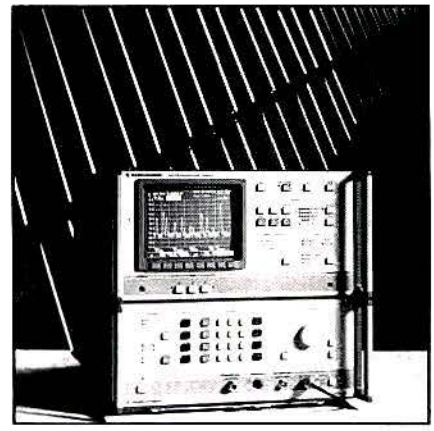
Cellular mobile changes to portable for travel



The FM 9210 cellular mobile telephone from **Philips RCS** transforms to a portable unit with a few, simple adjustments. The antenna and handle are attached to the unit for portable installation, as well as the battery pack. A mounting cassette holds the phone in the vehicle. The phone offers LED display with as many as 16 digits, user prompts, call time/cost function, external horn alert, 60-number memory, audible indicators and hands-free operation.

Circle (300) on Fast Fact Card

Tester incorporates spectrum, network analyzers



The FSAC tester from **Rohde & Schwarz** offers a spectrum analyzer, network analyzer and calibration receiver in one unit. The instrument covers 100Hz to 1.8GHz, and its uses include measuring field strength, testing antennas and cables, and radio-monitoring.

Circle (358) on Fast Fact Card

Adapter enables Type II interconnection

The **Hark MF** adapter allows compatibility with Type II interconnection requirements. The adapter allows DID trunk users to gain faster system through-put of calls.

Circle (448) on Fast Fact Card

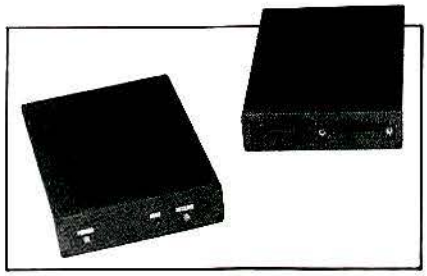
Paging terminal handles

Expanded alphanumeric message lengths may be added to **Commonwealth Communications'** Mark series of paging terminals. The terminal accommodates message lengths of as much as 1,000 characters in RPC1 (formerly POCSAG) and Golay formats.

Circle (327) on Fast Fact Card

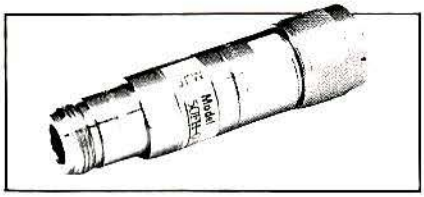
Data interface modem allows individual address

The LTR data interface modem from **E. F. Johnson** automatically switches the LTR mobile and repeater between voice and data communications modes. It offers individual modem address capability, automatic retransmission request, forward error correction, 4,800 baud or 1,200 baud operation and block data transmission.



Circle (360) on Fast Fact Card

Fixed attenuators span dc to 2,000MHz



High-power fixed attenuators from **JFW Industries** are available in dc to 2,000MHz. The units in 5W and 10W are available in 1dB to 20dB values; 3dB, 6dB, 10dB and 20dB are stock items.

Circle (396) on Fast Fact Card

Remote power monitor checks as many as 6 channels

The remote power monitor from **Trident Micro Systems** monitors forward and reflected RF power on as many as six channels. The unit also tracks temperature and as many as six voltages. Alarm conditions for each channel of each power monitor can be set, and the unit has six uncommitted open collector outputs that can be used to control other equipment at the site.

Circle (349) on Fast Fact Card

Universal network interfaces reformat paging data

The UNI-1 and UNI-2 universal networking interfaces from **Spectrum Communications & Electronics** install between any pair of different manufacturers paging systems and reformat paging data to suit another system. The interfaces can perform conversions simultaneously from system A to B and another set from system B to A. UNI-1 is a PC-based package with full universal networking software and all required interface circuitry. UNI-2 is a disk-based universal networking software; specifications governing the selection of an appropriate PC into which UNI-2 software can be installed are available.

Circle (350) on Fast Fact Card

Bases, mobiles, portables meet 821MHz trunking specs

National Public Safety Planning Advisory Committee (NPSPAC) versions of **General Electric's** digitally trunked public service stations, mobiles and portables are available. Encryption works on the narrow NPSPAC channels and will be offered with base stations, mobiles and portables.

Circle (321) on Fast Fact Card

Fiberglass cellular antenna offers 7dB gain for marine

The CMR1180 is a four-element collinear marine cellular antenna from **Ora Electronics**. Enclosed in fiberglass, the antenna offers 7dB gain. It fits standard marine mounting hardware.

Circle (395) on Fast Fact Card

Trunk concentrator processes 4 to 32 callers at once

The store-and-forward trunk concentrator (SFTC) for radiopaging and voice mail service providers acts as a standalone system. Made by **Real Time Strategies**, the unit processes from four to 32 simultaneous callers while forwarding completed requests to the host terminal.

Circle (353) on Fast Fact Card

Catalog covers multiplex products, systems

A catalog from **ISC Cardion** details the company's analog terrestrial microwave and direct-to-line CCITT-compatible voice multiplex, as well as other products and systems. Spec sheets of typical installed systems and equipment is included.

Circle (326) on Fast Fact Card

Brochure describes field recorder

Astro-Med's Dash II MT two-channel field recorder is described in an eight-page brochure. The unit offers frequency response to 500Hz full-scale, separate of overlapping channels. The brochure outlines other technology of the recorder.

Circle (328) on Fast Fact Card

Full line catalog lists tests instruments

A full line instruments catalog from **Marconi Instruments** outlines operating features and specifications for spectrum analyzers, oscillators, sweep generators, RF test equipment, power meters, signal generators and other testers. The catalog also reviews application notes and technical publications available.

Circle (375) on Fast Fact Card

In-store antenna brochure is available to dealers

A six-page brochure titled "the Interceptor" is available from **Ora Electronics** to dealers for point-of-purchase store use. The brochure focuses on the Interceptor automatic radio and cellular shut-off switch that turns off a car's radio system when a phone call is initiated or received.

Circle (327) on Fast Fact Card

Electronic catalog tallies more than 11,000 parts

The **MCM Electronics** catalog covers more than 11,000 parts and components. Categories include semiconductors, connectors, batteries, tools and test equipment.

Circle (377) on Fast Fact Card

Cellular handbook outlines operating systems, rates

The *New Cellular Handbook* from **Cellular Directions** contains information on more than 500 systems in the United States, Canada, Bermuda and the Caribbean. Systems on-line as of Sept. 1, 1988 are covered in the book, as well as coverage maps, rates, access numbers, dialing pattern and reciprocal agreement lists.

Circle (378) on Fast Fact Card

Data sheet features tone converter card

A data sheet from **Lucas Ledex** describes its model 2491 tone converter card. Features such as converting remote control DTMF codes to CTCSS, two-tone sequential and four-tone formats are discussed.

Circle (384) on Fast Fact Card

Book covers microwave digital radio

Microwave Digital Radio represents reprints of microwave radio information published by the **IEEE Communications Society.** The book is divided into six parts, each covering key issues that affect microwave digital radio. It is targeted for manufacturing, design and research engineers and engineering managers. Topics addressed include radio propagation, modulation and coding, and digital signal processing.

Circle (373) on Fast Fact Card

Catalog features installation products

Products used in installing equipment in automobiles are highlighted in **American Terminal Supply's** 1988-89 catalog. Connectors, disconnects, cable ties, crimping tools and cable clamps are among the products featured.

Circle (380) on Fast Fact Card

Packet radio book details commercial uses

Introduction to Packet Radio from **Kantronics** lists commercial applications of packet radio.

Circle (381) on Fast Fact Card

Data sheet describes time domain software

A data sheet from **Wiltron** covers its time domain measurement software option for its model 360 Vector network analyzer. Data includes modes of operation, windowing functions, gating functions and available displays.

Circle (382) on Fast Fact Card

Dispatcher's guide reviews common practices

The *Dispatcher's Guide to Crimes/ Incidents in Progress* from **Powerphone** provides information for the dispatcher to use in everyday operations. The manual provides guidance in a variety of areas: apprehension, correct call analysis, evidence preservation, extracting vital information, major disasters, protection of the offers and witness retention. Information printed in the manual is based on data received from 4,000 dispatchers.

Circle (379) on Fast Fact Card

Brochure describes alarm, control system

A brochure describing its 422 series alarm and control system is available from **Raven Electronics.** The information details the software program for control of all systems. It also describes applications and capabilities.

Circle (376) on Fast Fact Card

Catalog lists products for cellular, 800MHz

Tessco publishes a cellular telephone and 800MHz supports products catalog. Included in the publication is mobile antennas and accessories, cellular phone enhancements, service aids and test equipment.

Circle (329) on Fast Fact Card

Prices, small units make portables attractive

Portables are the fastest-growing product area in the land mobile radio industry, according to 50% of the responses garnered from the June 1988 "What Do You Think?" questionnaire. Readers were asked to check the group of products they considered to be growing the most. Mobile data terminals and trunking products also received high marks, as indicated by these percentages:

FASTEST-GROWING GROUP OF PRODUCTS	%
Portables	50
Mobile data terminals	34.5
Trunking products	28.1
Mobiles	21.9
Antennas	18.8
Computer products	18.8
Paging equipment	12.5
Base stations/repeaters	12.5
Test equipment	6.3
Power systems	6.3
SSB, ACSSB products	3.1
Combiners, multicouplers, duplexers	3.1

Those who checked portables as the fastest-growing segment of the industry attribute the development to technology's breakthrough in smaller, better and less-expensive units. "I have seen more improvement and expansion in portables than in any other item. Offshore competition of low-end market items has brought lower prices," comments one reader. "I sell 10 portables for each mobile because people like their convenience, features and prices," adds a reader.

"More businesses depend on portables," adds another reader. Portables are popular because they are "rugged and offer 24-hour, seven-day operations," notes a respondent. "Reductions in size, more reliability and the mixing of features" have helped portable technology to prosper, adds a respondent.

Mobile data terminals also are credited with expansion in the marketplace for various reasons, including the integration of data into traditional voice-only systems.

"Better data transmission via RF and cellular equipment" have spurred MDT's progress, notes a reader, adding "new technology allows more usage of mobile data." "Satellite location could expand into MDT," comments another reader.

"Data will affect the operation of everything else," comments a reader on why data is one of the fastest-growing industry segments.

Trunking products, as well, were named among the fastest-growing product groups. "Spectrum availability is making trunking a must. New services

are available to users via digital techniques," says a reader. "Customers want privacy" afforded to them with trunking, and the availability of 800MHz and 900MHz have enhanced trunking, notes another respondent. "We don't have cellular, so trunking is big," adds a reader.

Be sure to answer the "What Do You Think?" questionnaire on page 105 and return it so your responses can be included in a future "Feedback" column.

Technological advancements

Readers cite various technological advancements that factor into future acceleration of products. These include: "Cellular phones accessing satellite links directly." "More miniaturization." "Better batteries, smaller sized products and satellites."

"A new form of modulation or better Tx-Rx systems allowing adjacent channel usage without interference." "Submininiturize electronic circuits." "The mix of radio, computers and TV and the reduction in size of items."

Respondents continue: "Higher density batteries to give portables small size, high power and long endurance." "The use of digital technology for voice and data transmission will increase the usage of two-way products." "Advances in nicad battery or battery recharging." "Opening of the 900MHz band to more mobile applications, satellite communications interfaced with mobile radio and the development of ultra conductive materials."

People


Sandahl


Denning


Shikari


Hatfield

Joel Sandahl of Cellular Technology joins Quintron, Quincy, IL, as director of advanced development.

Carol Denning, inventory control manager, Maxon Electronics, Kansas City, MO, advances to operations manager.

Paul Gardner, program analyst for Piedmont Airlines in Winston-Salem, NC, joins MX-COM, Winston-Salem, as manager of data services.

Anees A. Shikari, engineer with GE Mobile Communications Division, Lynchburg, VA, joins ISC Cardion Electronics, Holtsville, NY, as director of marketing.

Dale N. Hatfield, president of Hatfield Associates, Boulder, CO, signs as an adviser to the National Association of Business and Educational Radio (NABER), Washington, DC, and agrees to write exclusively for NABER on land mobile communications issues.

Michael Blum, director of sales for Cellular Depot, joins Allied Communications, Bensalem, PA, as vice president of sales and marketing. **Jeff Lang,** Allied account supervisor, becomes director of sales. **Bart Schutzbank** of Cellular Depot is named account representative. **Hal Fuchs** of R.M. Norford becomes local territorial sales representative.

Terry Gainey, service coordinator of Racom Services, a GE dealer in Phoenix, AZ, advances to service manager. **R.E. "Bob" Sirls,** GE distribution development manager, joins Racom as sales manager.

Mauro Walker, vice president and director of advanced manufacturing for the communications sector of Motorola, Schaumburg, IL, advances to vice president and corporate director of manufacturing.

Tom W. Pick, district manager of PacTel's paging operations in Texas, joins Unipage, De Soto, TX, as western regional manager. **Ron Townsend,** sales manager for PacTel's Dallas paging operation, joins Unipage as eastern regional manager.

Appointments at the FCC, Washington, DC: **Lawrence R. Krevor,** to legal assistant to the private radio bureau chief; Colleen Boothby, to legal assistant to the common carrier bureau chief; **Melanie Haratunian,** to legal assistant to the common carrier bureau deputy chiefs.

Calendar

January

23-25—Cellular Telecommunications Industry Association 1989 Winter Meeting and Exposition, San Antonio Marriott Rivercenter, San Antonio, TX. Contact: 202-785-0081.

30-31—American SMR Network Association Expo and Winter Membership Meeting, Lake Buena Vista Palace, Orlando, FL. Contact: 202-331-7773.

March

15-18—National Association of Business and Educational Radio 1989 Annual Meeting, Fairmont Hotel, New Orleans. Contact: 703-739-0300.

19-22—Energy Telecommunications and Electrical Association '89, Louisiana Superdome and Hyatt Regency New Orleans, New Orleans. Contact: 214-578-1900.

21-23—Associated Public-Safety Communications Officers Gulf Coast Regional Conference, Arlington Convention Center, Arlington, TX. Contact 817-459-6151.

29-31—International Mobile Communications Expo, Las Vegas Convention Center, Las Vegas, NV. Contact: 303-220-0600.

April

20-22—Associated Public-Safety Communications Officers North Central Regional Conference, Woodfield Hilton Hotel, Arlington Heights, IL. Contact: 312-774-8568.

May

1-3—Vehicular Technology Society of the Institute of Electrical and Electronics Engineers Conference, Sir Francis Drake Hotel, San Francisco. Contact: Frank Thatcher, 415-956-6118.

3-5—Telocator Spring Meeting, Orange County Convention Center/Civic Center, Orlando, FL. Contact: 202-467-4770.

21-25—Associated Public-Safety Communications Officers East Coast Regional Conference, Marriott Hotel, Charleston, WV. Contact: 304-768-3732.

June

18-21—Utilities Telecommunications Council Annual Meeting, Lake Buena Vista Palace, Orlando, FL. Contact: 301-621-5596.

July

17-19—Forestry-Conservation Communications Association, Coeur D'Alene, ID. Contact: 208-765-1811.

Professional services

GE PORTABLE SERVICE

- FAST TURN
- WARRANTY
- $32.00 hr./2 hr. MAX
- PARTS GE LIST
- RETURN UPS PAID

Smith Communications Service
2121 PARRISH AVE.
OWENSBORO, KY 42301
502-683-0936

BILL SMITH

Consultants To The Cellular Industry

1990 N. California Blvd.
Suite 830
Walnut Creek, CA 94596
(415) 932-7010
(415) 932-8616 (FAX)

ALEX E. INFALD
President

DAI Marketing

---

(800) 247-4796

1152 St. George Avenue
Avenel, NJ 07001
201-636-6970

RAM
COMMUNICATIONS CONSULTANTS

Mobile & Microwave Radio Systems Consultants

Design
Construction & Service
On Specialized Micro Systems

INTERNATIONAL MICROSYSTEMS INCORPORATED

310 E. Polk
West Memphis, AR 72301
501-735-7751

TAC-5e & TAC-5 MANAGER
The ULTIMATE Interconnect
Equipment for the GE SMR

LIGHTNING PREVENTION SYSTEMS

LIGHTING PROTECTION AND PREVENTION SYSTEMS FOR COMMUNICATIONS TOWER SITES.

204B Cross Keys Road, Berlin, NJ 08009 FAX 609-767-7547
(609)767-7209
"Don't wait until it's too late!

James W. Hart, P.E.
President

HarTech, inc.
Telecommunications Consulting Engineering
Microwave • Two-Way Radio • Antennas • Policy Studies

P.O. Box 88
Littleton, Colorado 80160
303/795-2813

ADCOMM ENGINEERING COMPANY

Communications & Electronics Engineers

- Mobile Telephone & Paging
- Microwave Radio
- Fiber Optics
- Special Systems

(206) 821-8827 14631 - 128th Avenue N.E.
Kirkland, WA 98033

3710 N.W. 16th Street
Lauderhill, FL 33311
(305) 321-9371

RF ENGINEERING INC.
Communications Specialists

Public Safety & Paging
Analysis & Trouble Shooting

GARY EICHSTEADT
Consultant

YOUR CARD HERE
reaches 63,661 prospects
for as low as $66 per insertion.
Call 303/762-1249

JAMES H. BAKER
Executive Vice President

3025 Hilyard Street
Post Office Box 5446
Eugene, Oregon 97405
Phone 503/485-8441

FOREST INDUSTRIES TELECOMMUNICATIONS
the Forest Industry's Voice before the Federal Communications Commission

---

Stuart Meyer
LAND MOBILE CONSULTANT

2417 NEWTON ST
VIENNA, VA 22180
(703) 281-3806

FCC CALL
KB83540

MCCON

Mobile Communications Consulting
S. R. McConoughey, P.E.
Principal

13017 Chestnut Oak Drive
Gaithersburg, MD 20878 (401) 926-2837

RCT

RAYMOND C. TROTT
CONSULTING ENGINEERS, INC.
1425 GREENWAY DRIVE, SUITE 350
IRVING, TEXAS 75038
214/580-1911

RAYMOND C. TROTT, P.E.
PRESIDENT

LAND MOBILE / MICROWAVE COMMUNICATIONS SYSTEMS

FREDERICK G. GRIFFIN, P.E.
President

FREDERICK G. GRIFFIN, P.C.
A Professional Communications Engineering Firm

3229 WATERLICK ROAD
LYNCHBURG, VA 24502 804 237 2044

OMNICOM, Inc.
TELECOMMUNICATIONS ENGINEERING

GENE A. BUZZI
PRESIDENT

WOODCREST OFFICE PARK
325 JOHN KNOX RD./SUITE F-204
TALLAHASSEE, FLORIDA 32303
PHONE (904) 386-3180

RJO

Dr. Gregory M. Stone
Director National Security & Public Safety Studies

4550 Forbes Boulevard
Lanham, MD 20706
(301) 731-3600

HERB SACHS, CONSULTING
Specialist in Public Safety Communications

P.O. Box 729
Bowie, MD 20715
301-464-4268

R. James Evans
COMMUNICATIONS CONSULTANT

MEMBER IEEE-APCO
(517) 351-3252

2803 SOUTHWOOD DRIVE
EAST LANSING, MI 48823

Sales offices

WEST: San Rafael, CA—Dennis Hegg, Mktg. Mgr., (415) 491-1442
MIDWEST: Englewood, CO—Cathey Bonnefoi, Mktg. Mgr, (303) 762-1249
EAST: Englewood, CO—Ruth Breashears, Mktg, Mgr., (303) 762-1249
CLASSIFIED SALES—Diane Hite, (303) 762-1249

Classified

Advertising rates in **Mobile Radio Technology's** Classified Section are $54.00 per column inch, per insertion, with frequency discounts available. There is a one inch minimum.

Ads larger than one inch are sized in ¼-inch increments and billed accordingly, as determined by total size of the ad, including ruled borders and rounded up to the nearest ¼-inch.

Blind box ads (replies sent to **MRT** for forwarding) are $30.00 and Fast Fact reader service numbers are available for $25.00 per service, per insertion, to cover processing and handling costs.

Optional color, determined by **MRT** on an issue-by-issue basis, is available at $150 per insertion.

A prepayment discount of 5% is available for all 6x or larger frequency classified advertisers who prepay their full 12 month schedule.

No agency discounts are allowed for classified advertising.

Contact Diane Hite at (303) 762-1249 in Denver to place your classified ad, or send your classified advertising materials and order to: **Mobile Radio Technology,** Advertising Department, P.O. Box 12901, Overland Park, KS 66212.

RegencyPlus

If your business is selling radios, make sure you have radios that sell! Regency Plus! The perfect combination of price, performance and features.

Join the profitable Regency Plus team today. New dealerships are still available in many areas. Please call for details.

Regency Land Mobile, Inc.
7707 Records St.
Indianapolis, IN 46226
1-800-821-2900

MADE IN USA

Circle (95) on Fast Fact Card

Help wanted

MANAGEMENT

American Paging Inc. is one of the fastest growing paging companies in the United States. We are currently seeking general managers for city operations. Successful candidates will have had prior sales, collections and profit and loss responsibilities. We offer:

- excellent salary
- bonus program
- company paid benefits program
- car allowance

Please send resume with salary requirements to:

Mr. Austin Parchman
Director of Operations
American Paging Inc.
2780 Snelling Ave. N., Ste. 304
St. Paul, MN 55113

COMMUNICATIONS ENGINEERS

State agency recruiting for degreed electrical engineers with experience in land mobile radio communications. Application deadline: 1/31/89. Positions headquartered in Tallahassee, FL. Qualified applicants submit resume to: **Recruitment Office, Dept. of General Services, 1720 S. Gadsden, Tallahassee, FL 32399-0962. (904) 488-2707.** For additional information, please call John DiSalvo, (904) 488-3866. EOE.

LEAD TECHNICIAN

Quigley Communications Inc., a Motorola MSS in Southern, CA, seeks lead technician to perform service on mountain top repeaters, including SMRs, simulcast paging systems using Modax Plus terminals and PURC transmitters, etc. Position requires 4 years of 2-way experience, and an FCC General Class Radio/Telephone license. Send resume with salary requirements to:

Quigley Communications
4506 Federal Blvd., Ste. A
San Diego, CA 92102
Attn: Ronald Patterson

MASTER TECH POSITION

Five-plus years experience required on GE two-way, including 800 trunking mobiles/repeaters. Cellular knowledge a plus. Top dollar and benefits paid. Call:

(404) 924-7733
Georgia Mobile Radio

Atlanta's Leading 5-Star GE Dealer

COMMUNICATIONS SALES MANAGER

Needed for Central U.S. firm. Experience in marketing of professional two-way equipment required. Must have experience with trade shows, reps and managing sales and technical personnel. Send resume and salary requirements to **Mobile Radio Technology, Dept. 906, P.O. Box 12901, Overland Park, KS 66212.**

NETWORK MANAGER

A national radio paging firm is seeking a high-energy individual to manage technical operations for Southern California. Responsibilities include an aggressive projects schedule as well as maintenance of a regional network of transmitters and paging switches. A technical background and experience in project management are both essential for consideration. Please send resume and salary requirement promptly to:

PageNet
Attn: R.J. Turner
2121 Towne Centre Pl., Ste. 100
Anaheim, CA 92806

Pro/File Associates

Professional Placements in Communications

Successfully placing qualified individuals in the rewarding positions they deserve is our full-time job.

All placements are employer paid and applicant information is kept strictly confidential.

Call or write for additional information:

(602) 292-1088 5151 N. Oracle Road, Suite 208 Tucson, AZ 85704

Circle (96) on Fast Fact Card

Classified

Help wanted

SALES/ MARKETING ENGINEER

Use your extensive knowledge of two-way radio systems and electronics to help customers create applications for our state-of-the-art products. BSEE desirable.

ENGINEERING TECHNICIAN

Knowledge of digital and analog electronics, microprocessors and two-way radio are essential. Design and build production test equipment, etc.

Five years minimum experience required for each position. Leading industry salaries available. Send resume to:

Personnel Manager
CONNECT SYSTEMS INC.
23731 Madison St.
Torrance, CA 90505

LOOKING FOR TECHNICIANS AND COMMUNICATIONS PERSONNEL WITH EXPERIENCE IN MOBILE AND CELLULAR RADIO

Must have working knowledge in all phases of two-way work including closed circuit television. Salary commensurate with experience. Excellent fringe benefits. Please send resume to and/or call collect:

1-615-361-8506
Communications Services Company, Inc.
Glenn Cleaver
862 E. Hagan
Nashville, Tenn. 37217

SERVICE MANAGER TECHNICIANS/ SALES PEOPLE

Established E.F. Johnson Dealer looking for experienced qualified people. Excellent salary and benefits for people who meet our standards. Send resume to:

Western Electronics Company
Dan Dopita
604 N. Meadow
Odessa, TX 79761

U.S. Crystal Manufacturer requires production and design personnel. Experience in crystal design and production needed. Management experience helpful. Send resume and salary requirements to: **Mobile Radio Technology, Dept. 905, P.O. Box 12901, Overland Park, KS 66212.**

IMMEDIATE OPENINGS TELXON CORPORATION

Telxon, the leader in hand-held computer industry has openings for individuals with radio communications experience. Seek R.F. Engineer, digital data trans. low power, UHF, VHF communications. Also, with radio communication experience, positions exist for Systems Analysts, Programmers, Technicians and Senior Sales Reps. Salary commensurate with experience, benefits, send resume and salary history to **Telxon Corporation, DEPT. RF, 3330 W. Market Street, Akron,OH 44313 E.O.E.**

Services

DUPLEXERS RETUNED FAST ALL MAKES

48 Hr. Turnaround

also

- filter retunes
- isolator retunes
- repairs
- modifications
- double shield cables

We have 17 yrs. experience.
Call Dennis at
(716) 828-0290
CODEN ENTERPRISES, INC.
195 Burmon Drive
Orchard Park, NY 14127

SERVICE INSTRUCTION

38 lessons & tests written exclusively for mobile communications servicing. No Radar. No TV. Home Study. $375. Time payments available. Established 1960.

Mobile Training Institute
528 Pacific Terr. P.O. Box E
Klamath Falls, OR 97601-0021

MTI

(503) 882-5408

Equipment wanted

MOTOROLA RADIOS WANTED 800-231-0103

WE BUY AND SELL

Used and Re-Conditioned Cellular Car Phones. Contact: Kathy or Mo. **Cellular Success Systems**, a division of Trans-Atlantic Auto Imports, Inc.
(216) 831-9000

WE BUY NEW AND USED BEEPERS 150-159 MHz!

Looking to sell 900, 454 and 35 MHz pagers.

Contact:
Mike Steingold
(313) 569-7840

WANTED!
IMTS or RCC Car Phones

CONTACT: TOM BELISLE
(805) 251-2244 or
(800) 423-2565 (outside CA)

$WANTED$

Cash + Shipping paid "Promptly"
Motorola, GE, Johnson
Bases, Mobiles, Repeaters and Service Monitors
"NO JUNK"
Pulsar II VHF/Bell Phones
Barnett Electronics
800-423-3858
8718 Wilhite Lane • N. Little Rock, AR 72116

So much exposure. So little money.

Target 60,398 product and service buyers for a mere $54. Call Diane at *MRT* Classified, (303)762-1249.

Equipment for sale

MOTOROLA RADIOS

BUY & SELL

PORTABLES • PAGERS • REPEATERS MOBILES • BASES

- Selling **MOTOROLA** exclusively for 15 YEARS!
- We don't sell junk; if you buy from us . . . **IT WORKS!**
- All equipment totally reconditioned
- Every radio bench tested **TWICE!**
- P.L. Reeds **free** with order, if stocked.
- We sell to dealers at WHOLESALE.
- Quality Equipment . . . **NO SURPRISES!**

CALIFORNIA RADIO®

16943 - 6200 ROAD, MONTROSE, COLORADO 81401
Toll Free order line: 800-231-0103 Customer Service: (303) 249-1414
FAX LINE — 1-303-249-4334 WORLDWIDE TELEX — 510-100-5408

Circle (97) on Fast Fact Card

B-D CRYSTAL

Subsidiary of Hy-Q International

- Communication Crystals
- Pager Crystals
- Channel Elements
  - Recrystalled
  - Compensated
  - Complete Elements

48 HR. SERVICE AVAILABLE
(606) 283-5000
FAX (606) 283-0883

1438 Cox Avenue
Erlanger, KY 41018
(Greater Cincinnati Area)

Precision Quality Quartz Crystals
Made To Your Specifications

Circle (99) on Fast Fact Card

MIDLAND

(2) Complete Midland CMS overlays for GE Marc VE trunked system.
(75) Midland CMS trunked radios.

We'll beat any factory pricing!
Call Rick Rode at:
Cleveland Mobile Radio
(216) 749-1535

FOR SALE: MITEL TELEPHONE EQUIPMENT

SEALED BIDS will be received by the **City of Elmira, New York, Purchasing Dept., City Hall, Elmira, NY 14901-2792,** until February 15th, 1989, 1:00 P.M., for the following equipment:

Two (2) Mitel SX-200 PABX switches, complete with two (2) consoles each. Both are SMDR equipped (including printer) and loaded with other features. Documentation also included. One unit capable of 44 trunks and 96 extensions, other unit capable of 8 trunks and 32 extensions. Units new in 1982 and in excellent condition. Bids will be accepted for one or both units.

For further information, **contact Lt. Charles Cortright, City of Elmira Police Dept., at (607) 737-5641.**

Bids will be submitted in a SEALED ENVELOPE titled: BID FOR MITEL TELEPHONE EQUIPMENT. Bids shall be accompanied by a bid deposit in the amount of ten percent (10%) of bid in the form of a certified check or bank draft. Balance is due thirty (30) days after City Council approval. The City of Elmira reserves the right to reject any or all bids.

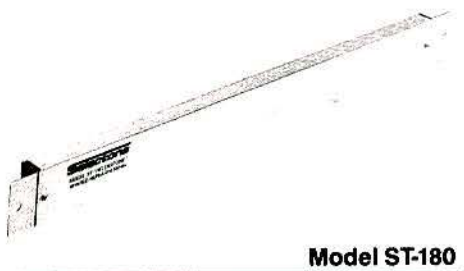
Circle (98) on Fast Fact Card

GENERAL COMMUNICATIONS

GENERAL ELECTRIC
MOBILE RADIO

GE MOBILE RADIOS AT WHOLESALE PRICES
MPI's—PHOENIX—PSX 200—PLS—MLS
MVS—MCS—TPX—TMX—MASTR II
DELTA—RANGR
1-800-356-3200 MADISON, WI 53719

SHARED REPEATER PANEL



Model ST-180

Selectone
23278 Bernhardt St. • Hayward, CA 94545
(415) 887-1950 • FAX: (415) 887-4011

New Shared Repeater Panel

- **Compact Size**—19"L x 1.75"H x 1.0"D
- **Digitally Programmable**—To any of the 37 RS-220-A CTCSS frequencies plus 97.4 Hz.
- **Busy Channel Lockout**—Prevents a different user from capturing the repeater during drop-out delay.
- **Tone Translation**—Allows retransmission of a different CTCSS tone than the one received.
- **Remote ON/OFF (Optional)**—Allows repeater owner to remotely shut-off non-paying customers.

CALL TOLL FREE: (800) 227-0376

Circle (100) on Fast Fact Card

Equipment for sale

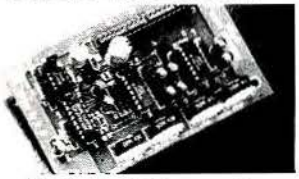
Misc. Andrews Parabolic Microwave Antennas. 4, 6, 8, 10 & 12 ft. Some with feeds & mounts. Tower mount microwave reflectors 4x6 ft., 6x8 ft., and 8x12 ft.

Telephone (604) 758-2652
Cercomm Electronics Ltd.
Tower Division

Motorola Pulsar II UHF Telco phones complete, as low as $400.
GL-2020 plus Aerotron 600TT30 VHF phones, as low as $600.

CSC Inc.
1-800-237-1840

UAI-10 AND UAI-20 UNIVERSAL REPEATER/LINK AUDIO INTERFACE



Detailed application manual
Low power operation, 19ma @ 12v
CTCSS decoder on the UAI-20 only
Assembled, tested, one year warranty
Link monitor-mix/monitor mute control
Adjustable repeater/link/DTMF audio outputs
Selectable DTMF mute on repeater and link audio
Repeater, link, auxiliary and control audio inputs

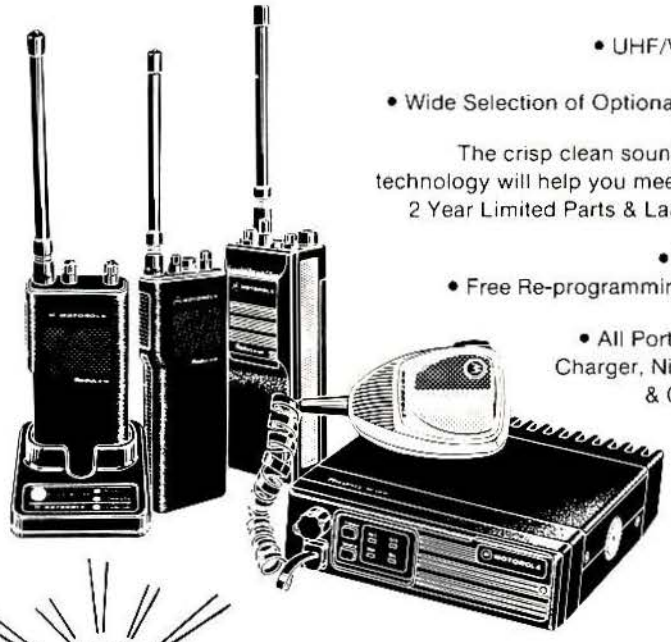
UAI-10	UAI-20
$44.00	**$89.00**

CREATIVE CONTROL PRODUCTS
3185 Bunting Avenue
Grand Junction, CO 81504
(303) 434-9405

MasterCard VISA

MOTOROLA Radius™

Mobile and Portable Two-Way Radios from $225 (All Radios Discounted!)



- UHF/VHF/800 MHz
- Repeaters
- Wide Selection of Optional Accessories

The crisp clean sound of Motorola technology will help you meet your needs. 2 Year Limited Parts & Labor Warranty.

- Free Delivery
- Free Re-programming for 2 years!
- All Portables include Charger, Nicad, Antenna & Carry Holster.

SALES AGENTS WANTED!

Contact Len Rusnak.

CALIFORNIA RADIO®

16943 - 6200 ROAD, MONTROSE, COLORADO 81401

Orders: **800-231-0103**

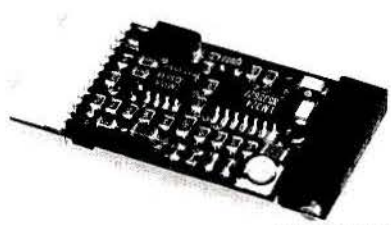
All Other Calls: **303/249-1414**

Circle (102) on Fast Fact Card

Plastidome equipment shelters, 12' long, 10' wide, 9' tall, including a/c, power panels, etc. Excellent condition. Located throughout U.S., $1,950 each. Also, **10KVA Uninterruptable Power Supply,** $3,800. Call **Megastar at (702) 386-2844.**

Make your classified ad stand out. Use color!

TONE SIGNALLING AND CONTROL EQUIPMENT



Model ST-146

Miniature Universal CTCSS Encoder/Decoder

- **Miniature Size**—Small enough to fit inside most portable and mobile radios (1.68"L x 0.81"W x 0.25"H)
- **Applications Versatility**—Field selectable output options for encode enable, decode activate, decode output, and high pass filter muting.
- **Fully Compatible**—with all CTCSS systems. Frequency range 67.0 Hz to 250.3 Hz.
- **Low Cost**—The best combination of small size and small price.

Selectone
23278 Bernhardt St. • Hayward, CA 94545
(415) 887-1950 • FAX: (415) 887-4011

CALL TOLL FREE: (800) 227-0376

Circle (103) on Fast Fact Card

Classified

Equipment for sale

Sharp COMMUNICATION

INSIDE ALABAMA
1-205-533-2484
CALL COLLECT

ASK FOR FREDA
1-800-548-2484

WHOLESALE PRICES ON
PLS'S, MPI'S, MLS'S,
MVS'S, PSX-200'S, accessories
800 MHz Trunking
Systems & Radios

Authorized Dealer
GENERAL ELECTRIC
MOBILE RADIO

800 MHz Trunking Systems
& Radios
3403 Governors Dr.,
Huntsville, Alabama 35805

Circle (104) on Fast Fact Card

MECHEM ELECTRONICS

Many more items are available.
Call or write for our flyer.

7012 Soulier Lane * Fredericksburg, VA 22401 * (703)786-7831

MOTOROLA MICOR BASE
1 C71RTB3146C 36-42 PL 100W Dual RX Tone
1 C71RCB3146C 36-42 PL 100W C.D. Dual RX Tone
1 L71BBB3430BM 36-42 or 42-50 PL 100W 2F Base
1 C42RCB3105D 72-76 Multi PL 30W C.D.
1 C53RTB3105D 150.8-162 60W DC Control
1 C53RCB1105D 150.8-162 60W C.D. Tone Control
1 C73RTB1106 150.8-162 110W Tone Control
1 C73RTB1126E 150.8-162 110W DC Control
2 B83RCB1106D 136-150.8 250W C.D. Tone

GE BASE REPEATER
1 DT74RBW22 33-42 100W CG 2F NB
1 DT76KFS66 150.8-174 100W CS 4F

MOTOROLA MOBILES
2 T51JJA4000BK 39-50 50W PL NB
12 T73BBN3900BA 162-174 100W PL 4F

MOTOROLA PORTABLES & PAGERS
2 P31DDC1102AM 42-54 5W CS 1F
2 H33BBU 3114A 150.8-162 5W PL 1F
1 APCOR UHF EMS 1W PL & Chargers
30 P1001BX DVP Programmers
2 & 6 A01MAC1568A 33-37 or 41-50 MC Tone only PBII
4 MAA02FNC2468AN 66-88 T&V PBII
7 A03MAC1568A 152.24 Tone only PBII
5 VHF Directors & Rack Chargers

MISCELLANEOUS
12 C1241 VHF Remote Radio Switch
8 6' Motrac Cabinets w/doors
MODCOM Equipment
12 SP3160469 MOT DC or Tone Remote w/TAC Comp.
1 B1203 Phone Patch
5 TLN1691B 100W PA Siren AMP

Circle (105) on Fast Fact Card

MAXRAD
Mobile & Base Antennas

CA Communications Associates Inc.

(800) 435-9313 In Illinois (800) 892-1611

Circle (106) on Fast Fact Card

Cellular Depot Inc.

Antenna Specialists — Audiovox

Bytek • DiamondTel • Fujitsu • G.E. • Mitsubishi • Mobira
Motorola • NEC • OKI • Sharp • Sony • Toshiba

Tele: (215) 364-7890
Toll Free: 800-421-9175
FAX: (215) 364-7899

WE BUY AND SELL USED MOTOROLA EQUIPMENT
Call us for more information and a quote.
TRI-COUNTY COMMUNICATIONS
(305) 975-6450
Call collect!

USED 2-WAY RADIOS
Call Sid Cohen
at AIR COMM—Phoenix, AZ
(602) 275-4505 • Fax (602) 275-4555
30%-70% savings on Motorola, GE, EFJ mobiles, base stations, portables, pagers, repeaters—primarily solid state—all frequency bands. Also, accessory items: Motorola "**Systems 90**" control heads. **PL and paging reeds,** channel elements.
Cash quotations made for purchase of above equipment.
AIR COMM
4614 E. McDowell Rd.
Phoenix, AZ 85008

LOW COST
24-12V Voltage Converters
List: $79.95 Dealer: $39.89
PBO11 Standard 10A units. 12A at 35% duty cycle. Ideal for boats, tractors and trucks.
Call: (800) 888-8797
LES WALLEN USA
Quality English antennas & accessories

USED PAGERS
Motorola and NEC. Reconditioned on your channel w/warranty or as is.
GE Exec. control stations, mobiles.
ACS
(303) 337-4811
FAX (303) 337-3084

Circle (107) on Fast Fact Card

WE BUY AND SELL USED
MOTOROLA AND GE FM TWO-WAY RADIOS
376 GE Portables, 490-512 MHz, PE55KFWFPX
5 MITREK, 460 MHz, T64JJA6000
20 MICOR, 152 MHz, T73RTN3100
8 MICOR, 152 MHz, T73RTN1100
5 MOCOM 70, 33 MHz, T71BBA4000
19 MOCOM 70, 33 MHz, U51BBN3000
SCHAEFER RADIO CO.
1301 Grant • P.O. Box 395
Denver, IA 50622 • 319/984-6115

RECONDITIONED VHF/UHF
IMTS MOBILE TELEPHONES

Call: Richard Page
Page Communications Co.
(714) 524-0568

Equipment for sale

GREAT LAKES COMMUNICATIONS SALES, Inc.
2060 E. Harbor Road Port Clinton, Ohio 43452

(800) 443-6262

HELPER INSTRUMENTS

TELEWAVE, INC.

Circle (108) on Fast Fact Card

Tower space

FIRST REPUBLICBANK PLAZA
DALLAS MAIN CENTER

Dallas' Tallest Tower

Dallas, TX Tallest Tower
The 74 Story First RepublicBank Plaza is now available for your Communications Facility.

- 900 MHz SMR Ready
- 900 MHz PCP/RCC
- 800 MHz Systems
- 150-450 MHz Systems

This one-of-a-kind roof top facility is dedicated to the Land Mobile Industry and has been featured in several magazine articles.

CONTACT:
JIMMY CHILES
(214) 761-6277

Circle (109) on Fast Fact Card

NORTHERN CALIFORNIA
Central valley plus foothills from two 2,000-foot plus locations. Call:
John Ryan
(916) 481-7000

TOWER SPACE
SOUTHERN CALIFORNIA
28 sites ranging from Santa Barbara to Mexican Border. Stand-by power.
Ask for Jack Reichler
MERIDIAN COMMUNICATIONS
23501 Park Sorrento, #213A
Calabasas, CA 91302
(818) 888-7000

TOWER SPACE
Prime Sites in Washington, D.C.
Baltimore, Maryland
Salisbury, Maryland
Two-way radio and microwave
Maryland Communications, Inc.
(301) 561-8255

Tower services

NEED SITE TENANTS??
Advertise your sites in the
NATIONAL COMMUNICATIONS SITE DIRECTORY
Effective, economical and the only publication dedicated to advertising antenna sites for sale or lease.
Where site managers and site lessors meet
NEED ANTENNA SITES?
Save time! Save money! The NCSD contains hundreds of prime antenna sites across the Nation for sale or lease.
To get your FREE copy of the NCSD, write or call:
******** INTRAFAM, P.O. Box 93, ********
Freehold, NJ 07728
(201) 462-5964

Tower services

Circle (116) on Fast Fact Card

WYCOFF TOWER
For installation of 2-way/microwave antennas and feed lines. Concentrate on 300 mile radius of DAL-FWT, Texas, but not restricted to. **Employment opportunities available.** Call or write: **520 FM661, Midlothian, TX 76065. (214) 775-3794.**

ANTENNA SITE LOCATOR
Nationwide, we find your site, quickly and economically.
American Site Network
Contact: Drunell Gross
(212) 477-4777

Repair services

Two Way Radio Repair Service
Mobiles & Handhelds
Regency, Wilson, Octagon, ICOM, Maxon, etc.
- References available
- Fast turn
- $30.00/hr. (2 hr. max. + parts)
- UPS paid return

TA Enterprises
986 Cherokee Rd. SE • Palm Bay, FL 32909
407-725-6167
Tim Downey, President

· Scanner Repair ·
Prompt service on all major brands.
Five-day turnaround. Avg. Cost = $35 + parts.
The Electronics Workbench
232 Main Street
Cumberland, ME 04021
(207) 829-3228

Circle (111) on Fast Fact Card

Repair services

PAGER REPAIR

GE BEACON, EXECUTIVE II, & ALL SHINWA PAGERS

ICM COMMUNICATIONS

P.O. Box 26330, 701 W. Sheridan, Oklahoma City, OK 73126

REEDS • CRYSTALS • PARTS

1-800 426-9825

SALES & SERVICE BUSINESS FOR SALE

Southern California. Serious inquiries only, please. Interested parties send contact information to: **Mobile Radio Technology, Dept. 907, P.O. Box 12901, Overland Park, KS 66212.**

REQUEST FOR PROPOSALS SUBTERRANEAN RADIO SYSTEM PILOT PROJECT

The City of Los Angeles Department of Telecommunications is soliciting proposals from qualified contractors to design and implement a pilot project to provide emergency two-way radio communications in a City-owned underground facility. Interested contractors contact:

Patrick Morgan
Communications Engineer
120 So. San Pedro St., Suite 600
Los Angeles, CA 90012
(213) 237-1164

Responses to the RFP are to be submitted by 4:00 p.m. January 31, 1989.

Computer products

$275.00 "MICROWAVE **TGS** **$275.00 "MULTIPOINT"**

Quality Microwave and Point-To-Multipoint Calculation Programs

Technical Specifications • Sample Printouts • Information

Technical Communications Software

P.O. Box 884, Montgomery, TX 77356 — (409) 582-6637 (Texas: add 6%)

IMSITE™

Advanced site development/maintenance software pkg. for IBM PC, XT, AT, PS-2.

IMST5x9, 4x5™
Intermodulation analysis 200 transmitters x 200 receivers, products to ninth order, up to 5 simultaneous transmitters, printed reports. Creates, maintains common IMSITE™ site files.

IMAGE 2™
Image pre-processor for IMST XXX programs.

CYBORG HUNTER™ Included
Complete expert system interference/intermodulation analysis and tracking (200 x 200). Uses common files.

TOWERS™
Graphical site record, representation. IKON based dedicated mini-drawing system.

Package includes above plus quick reference card manual, tutorials, data-bases.

For consulting engineers, systems managers, service managers. $250. **After January 1, 1989—$350.**

CyberSym, P.O. Box 227, Blacksburg, VA 24063. (703) 268-5400.

Circle (115) on Fast Fact Card

C$ERVICE™
Communications Service Shop Computer Software

- Invoicing—T&M/Contract/Rentals
- Customer Files
- Technician Efficiency
- Work Ticket Log/Tracking
- Accounts Receivable—Monthly Statements
- Inventory—Shop/Service Vans
- Maintenance History
- Interface to Motorola & G.E. Pricing Disks
- Interface to Peachtree Accounting System
- Radio System Design—Interference Analysis—Distance/Azimuth

All programs are fully interfaced.
Multiple companies, multiple shop locations.
Available for IBM & compatibles/
Demonstration program available for evaluation.
Packages starting at $1,150.00

America West C&E, Inc.
311 Washburn Drive
Rock Springs, WY 82901
307-382-5663

Circle (110) on Fast Fact Card

Business prospects

LAS VEGAS SCA FOR LEASE

Class C FM at 93.1
Full Power

Operating at 9,000 Feet

(702) 736-9393

18-CHANNEL SOLID STATE AEROTRON COMMUNITY REPEATER

Perfect condition. Currently in production. Never been modified. Has never needed repair. Current gross $9,500 a year. Coverage area: greater Boston. Write or call: **Aldo Quattrocchi, 30 Granite St., Norwood, MA 02062, (617) 762-0668.**

ADVANCED INTERMOD PC SOFTWARE—$175

Up to 10 times faster than prev. versions. 200 Tx and Rx freqs. to 9th order. Help and tech files; selectable speeds, band widths, orders. Prints reports in plain English text.

Updates for present users—$75.

MECH-ELEC SYSTEMS

(303) 674-1101

Cellular services

CELLULAR DEALERS

$ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $

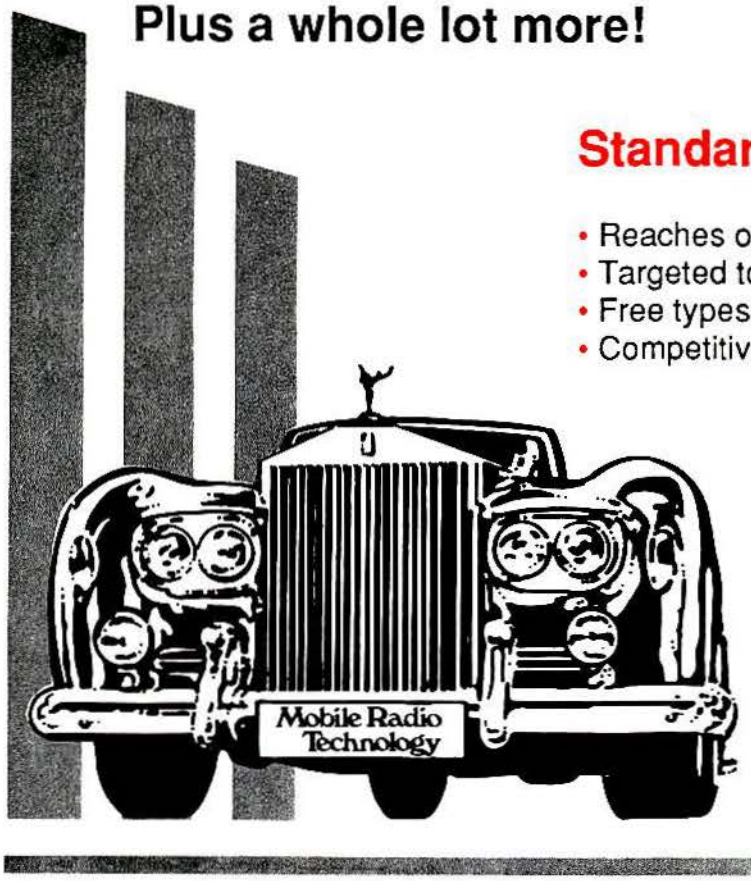
COMMISSION

Numbers available throughout USA

National Phone Number Center
1-800-456-7626

You get what you pay for with Mobile Radio Technology Classified. . .

Plus a whole lot more!



Standard Features:

- Reaches over 24,000 qualified sales prospects
- Targeted toward the technical decision maker
- Free typesetting and paste-up available
- Competitive price

Optional Extras:

- Reader Service number
- Color
- Blind box number
- Special positions when available

CLASSIFIED ADVERTISING ORDER FORM

Company _____

Street _____

City _____ State _____ Zip _____

Contact Person _____ Telephone _____

Check:

☐ **Please send me more information about advertising frequency discounts.**

☐ **Run my ad as shown below and call me for further instructions. (Attach sample layout if possible.)**

Headline: _____

Copy: _____

_____

_____

_____

_____

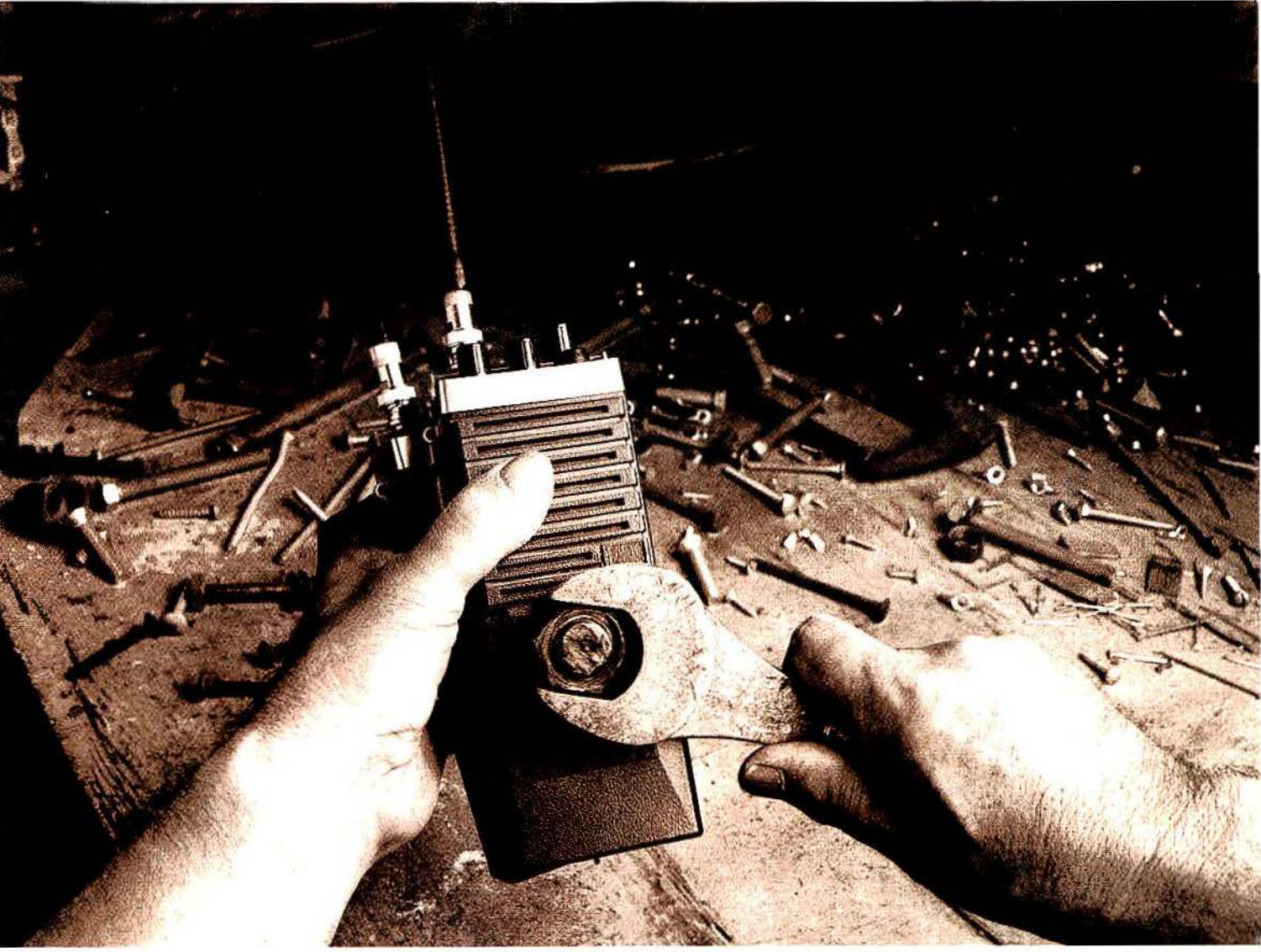
_____

Signature _____ Date _____

Mail to: Diane Hite
MRT Classified
333 W. Hampden Ave., Suite 606
Englewood, CO 80110
(303)762-1249
Fax: (303)762-0069

Ad index/hotline

Company	Page Number	Fast Fact Number	Advertiser Hotline
A.I.E. (Measurements)	82	74	803/532-9256
Ace Communications, Inc.	87	80	800/445-7717
Advanced Electronic Applications, Inc.	73	63	206/775-7373
Alexander Batteries	21	18	515/423-8955
Allgon Antenn, Inc.	31	27	214/641-3887
Antenna Specialists Co.	IFC	1	216/349-8400
Atkinson Dynamics	88	81	415/583-9845
B-D Crystal	97	99	606/283-5000
Band-It-Idex	8	8	303/320-4555
Barnett Electronics	96,98		800/423-3858
BEE Electrolcs, Inc.	92	86	800/336-3115
Bird Electronic Corp.	90	93	216/248-1200
Bomar	44	39	800/526-3935
Bramalea, Inc. (First Replub. Bk.)	101	109	214/761-6277
BRAMCO	74	64	513/773-6255
C T Systems	11,43	11,38	800/245-6356
California Radio	97,99	97,102	800/231-0103
Celwave	17	14	201/462-1880
Centurion International, Inc.	33	29	800/228-4563
CES, Inc.	7,85	7,76	800/327-9956
Cetec Vega	1	4	818/442-0782
Coded Communications	25	21	800/325-0147
Commonwealth Communications Industries Ltd.	69	58	800/633-8844
Communications Associates	100	106	800/435-9313
Communications Specialists	BC	3	800/854-0547
Connect Systems, Inc.	19	16	213/373-6803
Control Signal Corp.	14	12	303/989-8000
Crescent Radio Elec.	98	101	504/885-9511
Curtis Electro Devices, Inc.	42	37	800/332-2790
Cushcraft/Signals Corp.	83	90	603/627-7877
Data Signal, Inc.	77	62	912/883-4703
Decibel Products, Inc.	37	33	214/631-0310
Doppler Systems, Inc.	88	82	602/488-9755
Dynatech Tactical Communictions, Inc.	67	67	800/233-8639
Erie Electronics, Inc.	82	75	716/833-8400
Gamber-Johnson	92	87	800/826-0440
General Communications, Inc.	27	22	800/356-3200
Glenayre Electronics	35	31	206/575-0888
Great Lakes Communications	101	108	800/443-6262
Hadron, Inc.	30	25	703/359-6100
Harger Lighting Protection	86	78	312/362-4848
Helper Instruments Co.	46,89,91	42,85,92	800/327-9308
Henry Radio	39	34	213/820-1234
ICM Communications	22	19	405/236-3741
ICM Communications	102		800/426-9825
IFR Systems, Inc.	15	13	316/522-4981
II Morrow	52	47	503/581-8101
Kustom Electronics, Inc.	41	35	913/492-1400
Larsen Electronics, Inc.	23	20	206/573-2722
Lightning Master Corp.	93	88	904/799-6800
Magnavox	29	24	516/667-7710
Marconi Instruments	9	9	800/233-2955
Maxon	71	60	816/891-6320
Maxrad, Inc.	74	65	312/595-3933
Mechem Electronics	100	105	703/786-7831
Midian Electronics, Inc.	79	70	602/884-7981
Midland International LMR	47	43	800/MID-LAND
Modublox & Co., Inc.	78	69	619/456-0016
Multiplier Industries Corp.	53	48	800/642-2424
MX-COM, Inc.	34	30	919/744-5050
NCE/National Custom Enterprises, Inc.	10	10	612/890-1360
Norcomm Corp.	89	91	800/874-8663
Pac-Comm Wireless Data Sys., Inc.	48	44	813/875-6417
Pace, Inc.	55	49	301/490-9860
Panasonic Industrial Co.	57	51	201/348-7933
Parkinson Electronics Co.	90	94	800/332-7003
Polyphaser Corp.	58	52	702/782-2511
Positron Industries	91	83	514/738-2200
Primus Electronics Corp.	20	17	800/435-1636
Pro/File Associates	95	96	602/292-1088
Quintron Corp.	49	45	217/223-3225
R F Gain Ltd.	80	71	800/645-2322
Ramsey Electronics	70,75	59,66	716/586-3950
Raven Electronics Corp.	46	41	702/359-3700
Reach Electronics	87	79	308/324-6661
Regency Land Mobile	95	95	800/821-2900
Scala Electronic Corp.	18	15	503/779-6500
Schlumberger Instruments	61	54	617/229-4825
Scientific Dimensions, Inc.	56	50	800/523-6180
Securitron Co.	30	26	408/263-6434
Selectone	65,97,99	56,100,103	800/227-0376
Sharp Communication	100	104	800/548-2484
Shinwa Communications of Am	32	28	405/232-7272
Shure Brothers, Inc.	81	73	800/257-4873
SMC Electro-Mount	72	61	800/527-1079
Solid State Communications	3	5	415/785-4610
Sti-Co Industries, Inc.	93	89	716/881-3287
Sweet Electronics	78	68	618/939-3870
Synthex Communications USA	86	77	702/731-1516
Telewave, Inc.	59	53	415/968-4400
Tessco	45	40	800/638-7666
TPL	36	32	213/256-3000
Transcrypt Intl., Inc.	5	6	800/228-0226
Unipage, Inc.	51	46	214/224-3509
Vocom Products Corp.	91	84	312/885-3296
Wacom Products, Inc.	80	72	817/848-4435
Wilmore Electronics	42	36	919/732-9351
Yaesu USA	IBC	2	213/404-2700
Zetron, Inc.	63	55	206/644-1300



Yaesu solves the Dual-Band Dilemma.

Introducing the Yaesu FTH-2070. The first, and only, commercial dual-band hand-held radio.

With a 20 MHz frequency range in both UHF and VHF, 32-channel capability, and multiple-tone options (including burst tone, DPL, and a two-tone encode), the new FTH-2070 is unlike any other radio you've ever seen.

Or heard.

Need more convincing? The new FTH-2070 comes with a built-in time-out timer, a high/low power feature, activated by the press of a button, a powerful one-amp NiCd battery, and a state-of-the-art channel/message display.

And these are just the standard features.

Options for the new FTH-2070 include a "jerk and run" mobile amplifier charger, the NC-35 quick charger, or the NC-36 desk-top multi charger. There's also a service kit that lets you program your unit from any IBM-PC® compatible computer.

For pricing and ordering information, including details of the lease/purchase program designed exclusively for governmental agencies and large-volume buyers, call toll-free 1-800-999-2070.

With all the features of the new Yaesu FTH-2070, it's no wonder people are using it with twice the frequency.

And communicating twice as effectively.

YAESU U.S.A.

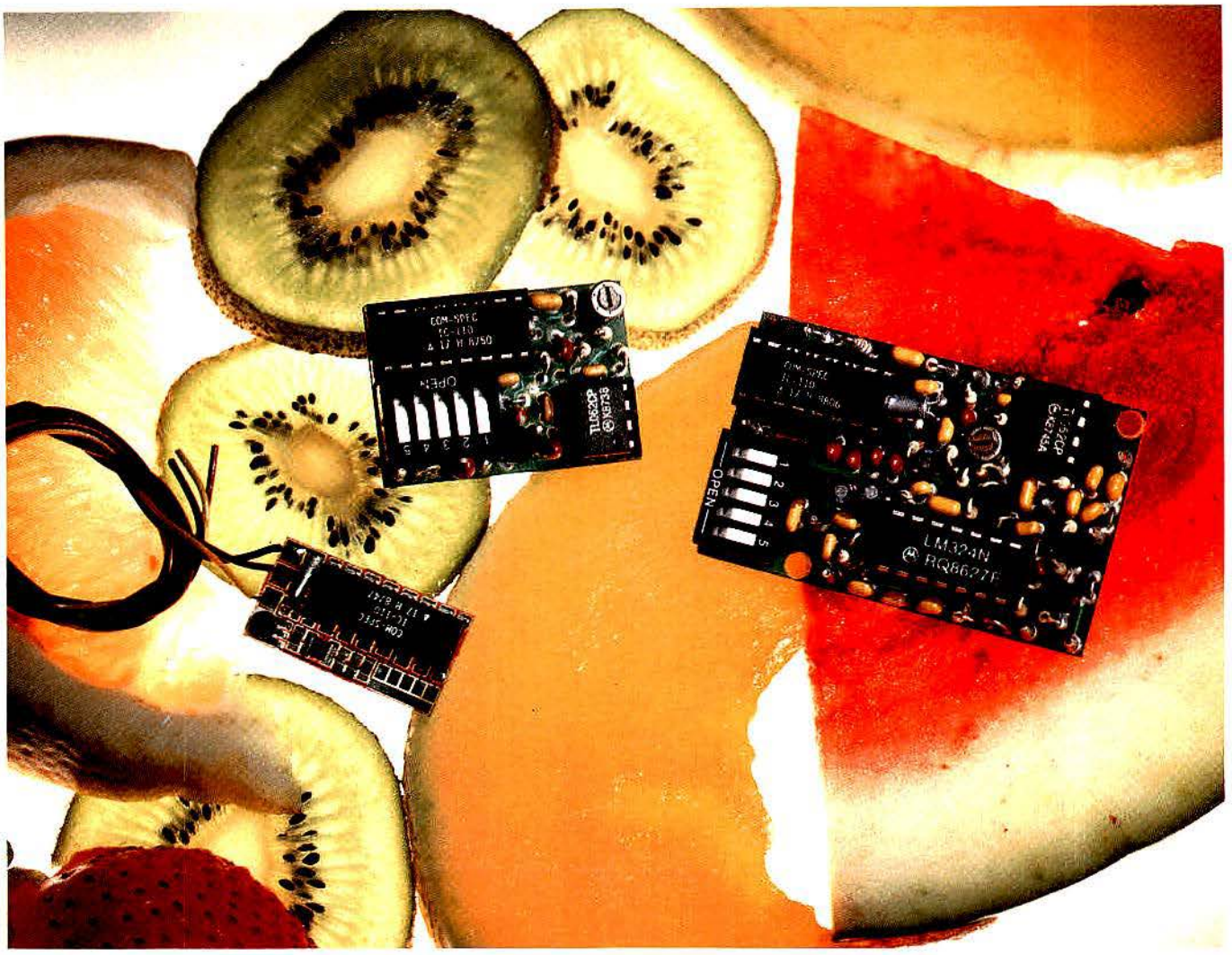
Commercial Products Division
17210 Edwards Rd., Cerritos, CA 90701
Telephone: (213) 404-2700

FCC Type acceptance pending.

FTH-2070

* IBM is a registered trademark of International Business Machines Corporation

Circle (2) on Fast Fact Card



Choice Selection.

Now you can have it all! Take all the qualities you've come to depend on in our programmable CTCSS tone equipment: Astonishing Accuracy, Instant Programming, Unequaled Reliability; and add full spectrum tone versatility, multi-tone capability without diodes, a reprogrammable memory... It's our new harvest of CTCSS tone equipment.

The choice is yours! If standard CTCSS EIA tones do not suit your taste, select any 32 tones of your liking from 15.0Hz to 255.0Hz. And if you change your mind, no problem; the memory can be changed in your shop with our HHP-1 programmer, or at our factory for free. Your working tone is accessed by a simple DIP switch, so there's no fussing with counters or other test equipment.

Call today toll-free and find out more about this fresh new flexibility in tone signalling, and don't forget to ask about multi-tone switching without cumbersome diode networks or binary switches.

It's all brought to market by the people who introduce the freshest ideas in tone signalling, and of course our customary same day shipping and one year warranty apply.

TS-32P CTCSS ENCODER-DECODER Based on the time proven TS-32, the industry standard for over a decade. The TS-32P gives you the added versatility of a custom, changeable memory base. A low price of $57.95 makes it an even sweeter deal.

SS-32P ENCODER Based on the equally popular SS-32 encoder. Available for CTCSS, or audible burst tones up to 6550.0Hz. Price is $28.95.

SS-32SMP SUB-MINIATURE ENCODER Our smallest encoder for handheld applications. Now you can satisfy that customer that needs to access multiple repeater sites with a radio that has precious little space inside. At $27.95, the price is small too.

HHP-1 HANDHELD PROGRAMMER For programming the 32 memory locations in any of our new programmable products, including our SD-1000 Two-Tone Sequential decoder. The HHP-1 is battery operated for field use, and will program ANY 32 tones from 15.0 to 6550.0Hz in .1Hz. increments. Price is $199.95.

MasterCard VISA

COMMUNICATIONS SPECIALISTS, INC.

426 West Taft Avenue • Orange, CA 92665-4296

Local (714) 998-3021 • FAX (714) 974-3420 • **Entire U.S.A. 1-800-854-0547**

Circle (3) on Fast Fact Card